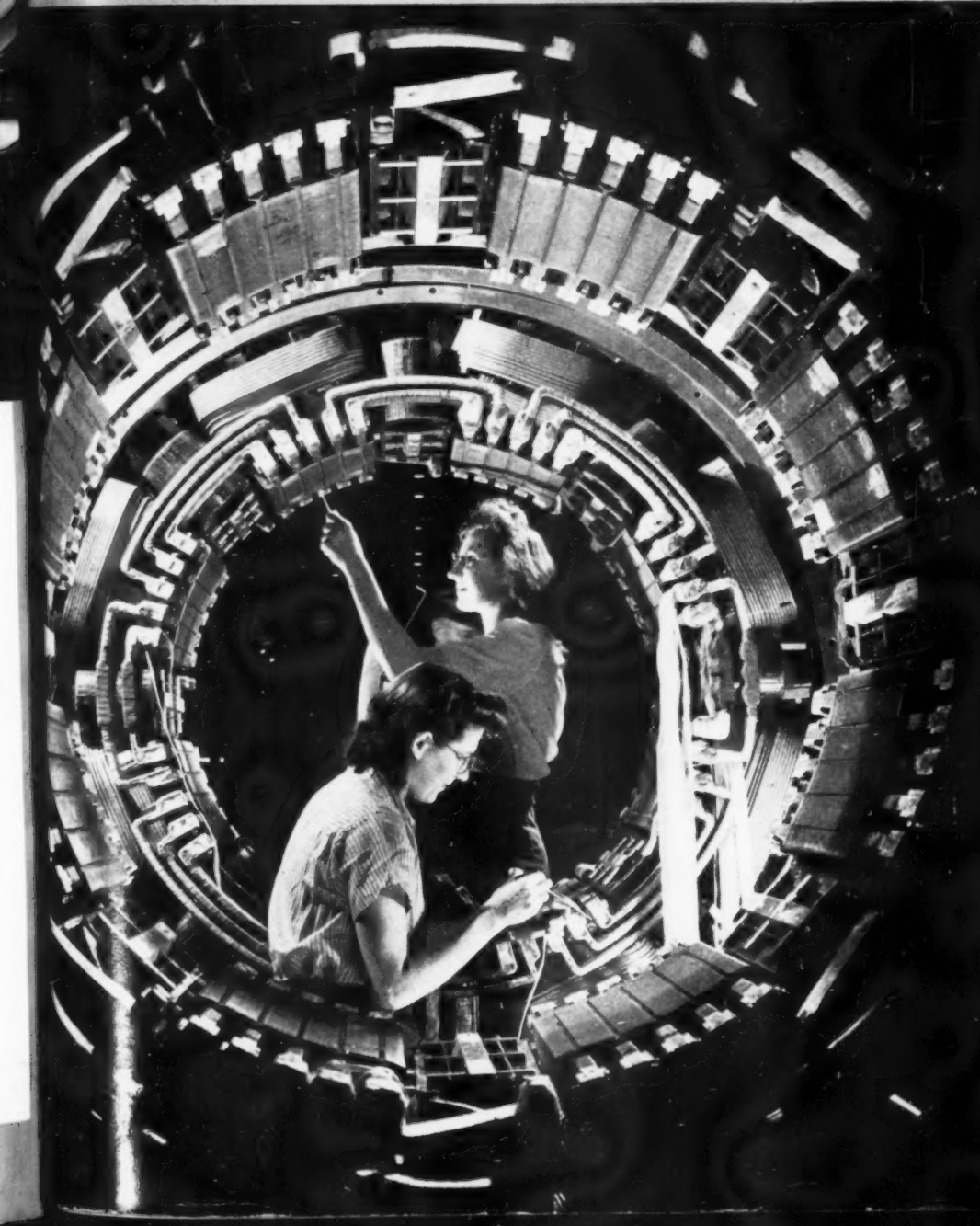
TECHNOLOGY DEPT.

POWER

NOVEMBER, 1943

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY



West Coast gets its first steel mill—another Kaiser miracle. Its boilers are the only ones west of the Rockies burning blast-furnace gas; its power distribution and utilization system represents best modern practice. Associate Editor Tucker's on-the-spot story begins on page 64

Transformer output depends on cooling—for full information on advantages and limitations of modern methods and the types and conditions to which they can be applied, turn to page 72

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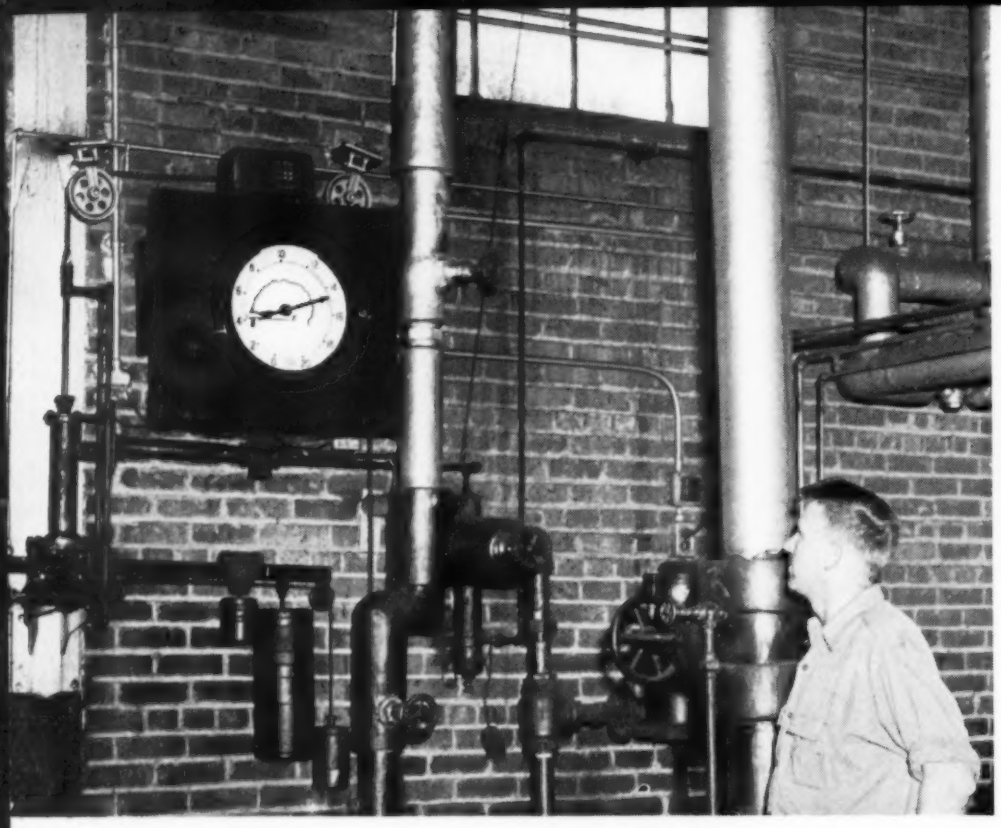
Page 59

Women tapers in Westinghouse East Pittsburgh Works insulate stators for Navy



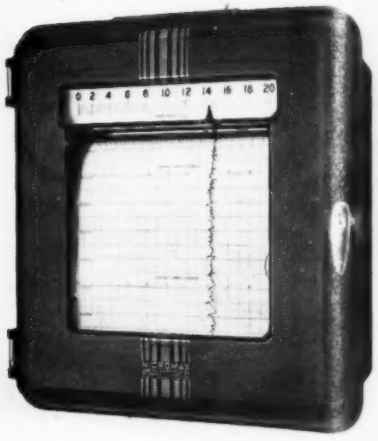
Located high above the floor so that it can be read far down the firing aisle, this Micromax Round Chart CO_2 Recorder helps a New York State plant to save coal by improving combustion beneath its stoker-fired boilers.

TRYING TO SAVE FUEL?

Maybe a Micromax CO_2 Recorder Can Help

Freed by the Micromax CO_2 Recorder from the job of analyzing flue-gas, at frequent intervals, many a plant engineer is saving fuel simply because he knows more about CO_2—and knows it more quickly—than ever before. For when the Micromax shows the need of a change in air supply to the boiler, the engineer makes the correction with speed; and quickly sees the result on the Recorder's chart. He can tell, from minute to minute if he wishes, just how combustion stands in relation to optimum efficiency. And he has the CO_2 records to help plan future operating savings.

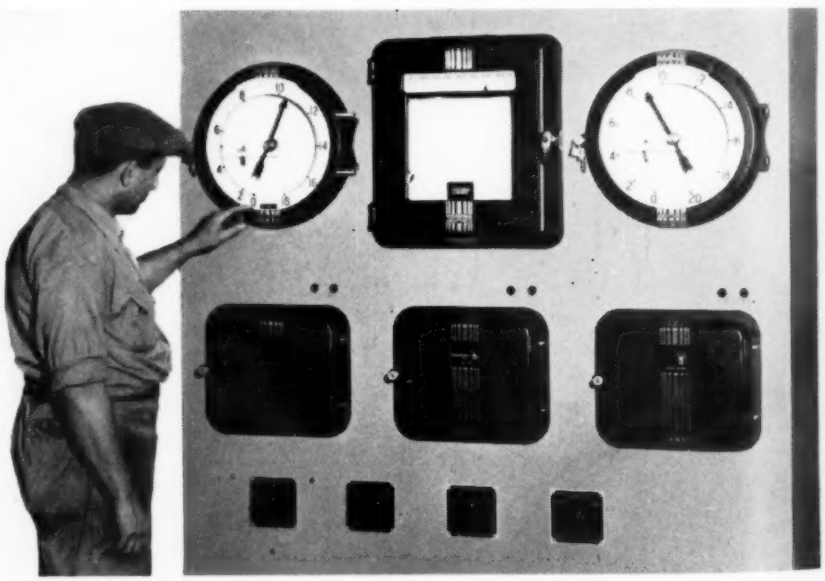
One of the outstanding successes of modern instrumentation has been scored by this Recorder. Coming into the power field when CO_2 recorders were widely regarded as not practical, this instrument was on a "make good if you can" basis in every early installation. Two or three types of CO_2 meters were already available; the arrival of still another didn't rouse much comment—at first.



The Strip-Chart form of Micromax CO_2 Recorder is preferred by some users.

But the comment came quickly enough after a few installations had been made, because the new device overcame the standard objections to automatic CO_2 meters—it was sensitive, it was not easily damaged in use, and it required practically no servicing. Users checked it; found it accurate; could see for themselves its other qualities; came to depend on it.

Today, wherever any thermal-conductivity-method recorder can be used, these advantages of sensitivity, sturdiness and low maintenance can be enjoyed. If you have a CO_2-analysis problem, one of our engineers will gladly tell you more about Micromax. If you prefer a quick, clear, printed description, ask for Catalog N-91-163.



Micromax Recorders for Flow, Temperature and CO_2, being mounted, together with Metermax Combustion Control, on a boiler-control board before shipment from our plant. These panels arrive ready for connection to boiler, etc.; greatly simplify the installation.

ARMY-NAVY E

depends on me!

A Slogan For Every American

Jrl Ad N-91-163(12)

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

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MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"). November, 1943. Vol. 87, No. 11. Published monthly with an additional Directory number in December. Return postage guaranteed. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, 1, N. Y. EDITORIAL AND EXECUTIVE OFFICES, 330 WEST 42ND STREET, NEW YORK, 18, N. Y. Entered as second class matter, August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, Power, 330 West 42nd Street, New York, 18, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

AN ELEVATOR, A CONVEYOR AND FEEDER IN A SINGLE UNIT

Bulk-Flo CONSERVES IN MANY WAYS

Bulk-Flo is outstanding in its ability to cut handling costs and to conserve critical materials and save space. It minimizes breakage and degradation, prevents leakage and reduces explosion and fire hazards. The necessity for multiple elevating and conveying units is eliminated, because the same unit conveys horizontally, vertically or on an incline.

Bulk-Flo is self-feeding, self-discharging and to a high degree self-cleaning. It handles coal and other flowable materials under all conditions of loading. It loads automatically —at one or at several points—without feeders. It automatically discharges at the head end of vertical runs or at one or more points on horizontal runs, or both as desired.

LINK-BELT COMPANY

Chicago 9 Philadelphia 40 Indianapolis 6 Atlanta Dallas 1 Minneapolis 5 San Francisco 24 Toronto 18

Offices, warehouses and distributors in principal cities.

Saves Space

Bulk-Flo is unusually compact, effecting a considerable saving in space requirements and supporting structure.

More Flexible

Bulk-Flo can be laid out to carry vertically, horizontally, around corners, along curves and on slants of any degree. Loading and discharge points can be located to suit. Tandem units can also be used.

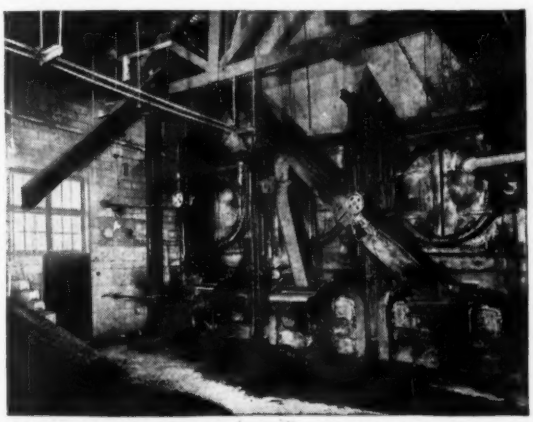
Self-Feeding, Enclosed

Bulk-Flo is self-feeding to capacity from bins, hoppers and chutes. It cannot flood. Material is moved in a dust-tight casing. It operates under partial loading with as high efficiency as when fully loaded.

Slow Speed; Large Capacity

Because the material in a Bulk-Flo moves en masse, the speed is slow; usually 30 to 60 ft. per minute. Large capacities are obtainable by large duct cross section, rather than by speed.

An interesting application of Bulk-Flo conveyor-elevator-feeder to the handling of coal in a plant power house. The Bulk-Flo transfers coal from bins near floor level to a screw conveyor which distributes it to stoker hopper.



Vertical run of Link-Belt Bulk-Flo unit (left) in boiler room. 3-way chute system to three boilers and chute to reserve storage pile on floor. Bulk-Flo receives coal from hopper under railroad cars.

9105-A

THE SYMBOL OF QUALITY LB LINK-BELT

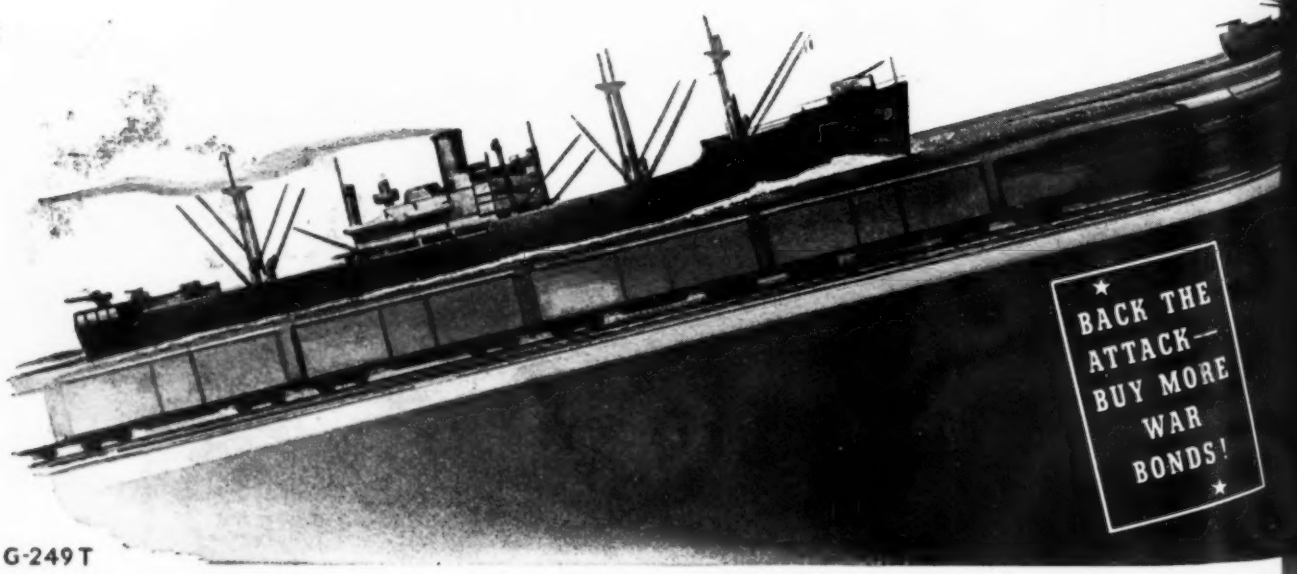
Rebuilding a World is for STEAM

The tough tasks of steam plant rehabilitation and development, will fall on engineers who are now serving their country in the armed forces, or in the never-ending battle with power-plant problems in war plants and in public utility plants supplying power to war plants. In this they are applying their engineering knowledge and skills to the early conclusion of hostilities.

When the war will have ended and Victory is ours, these engineers will re-direct their knowledge and skills from war-making activities to the production of steam power for peaceful pursuits, utilizing whatever of their background of war experience is applicable to future industrial development.

We of Babcock & Wilcox have implicit confidence in their resourcefulness, confidence in their ability to continue overcoming almost impossible assignments. Serving other engineers has also kept us on our mettle, as evidenced by important B&W contributions to the continued evolution of practice in steam generation.

While the war effort has first call on your industry's time and resources, you undoubtedly have given some thought to the postwar power-plant problems that will confront you, as it is never too early for engineering planning. B&W engineers will gladly cooperate with you to the utmost of their ability, consistent, of course, with war demands on their time.



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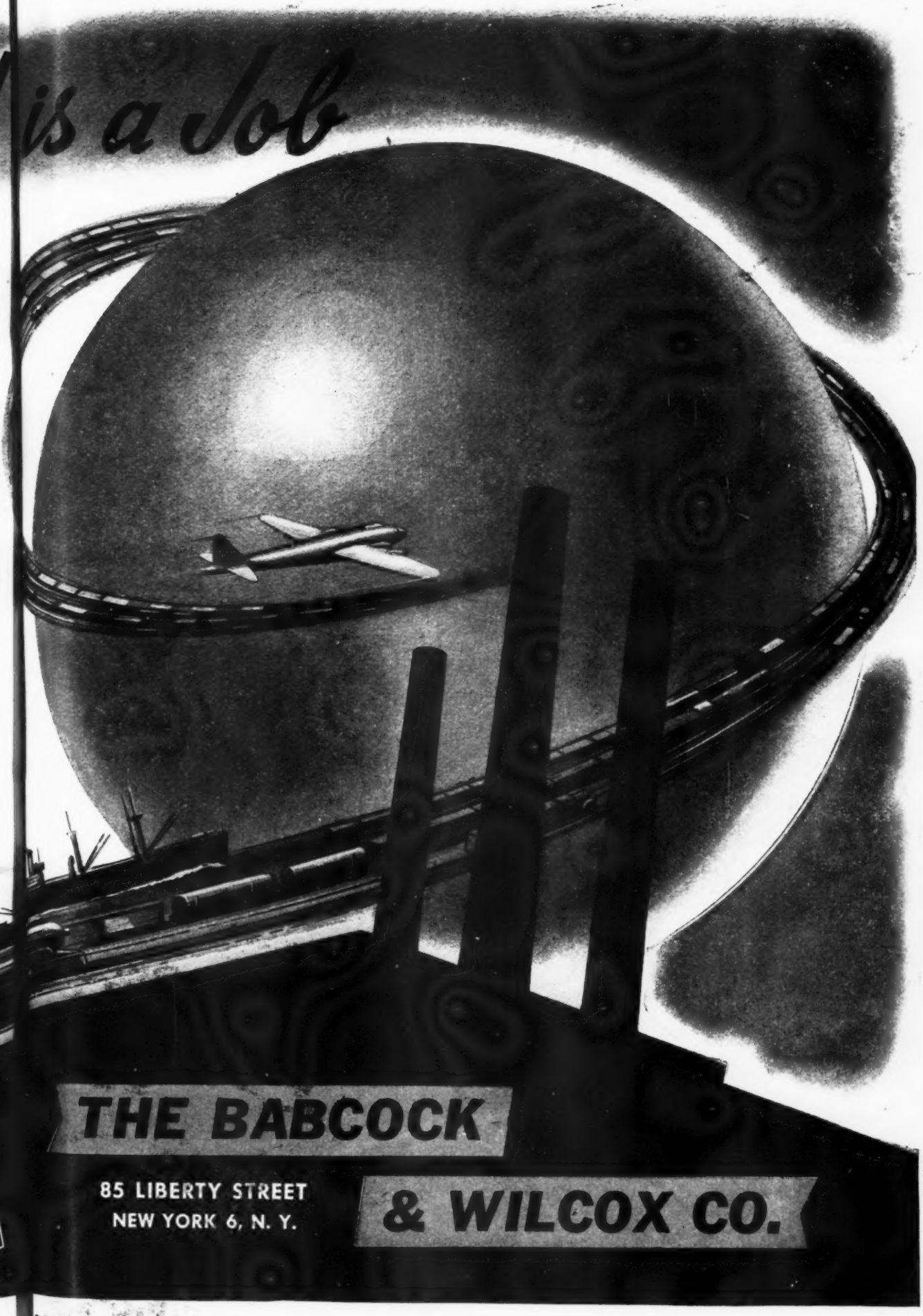
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COMBAT TEAM
on the power front—

They call them "combat teams" on the fighting front, these coordinated units of tanks, planes, artillery and infantry, organized to work closely with each other as a single fighting group, to the extreme discomfiture of the enemy. It's an American development, and a very successful one. Its basis is teamwork, American style.

You'll see it illustrated in power plants, too. The photo shows a typical one—an Elliott condensing turbine-generator unit. The turbine, designed to the job with extraction points to suit the most economical heat balance, works hand-in-glove with its highly efficient Elliott-built generator. The Elliott surface condenser is designed from hotwell to steam dome exactly to serve the needs of the Elliott turbine above it. The condenser is served by an Elliott ejector and has Elliott turbines and motors driving the circulating and condensate pumps.

Included on the Elliott team in this plant is a deaerating feedwater heater. It uses steam extracted from the main turbine to heat feedwater to saturated steam temperature and by deaeration it protects the boiler system from oxygen corrosion.

The whole set-up is a coordinated unit for economical power production and is the exact counterpart of the combat teams that are showing the Nazis some new angles on warfare.

The combined unit in the photo is of 6000-kw capacity, typical of many which are making the Elliott monogram a synonym for dependable performance in power plants serving war industry in many localities.

A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

ELLIOTT COMPANY

JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, OHIO

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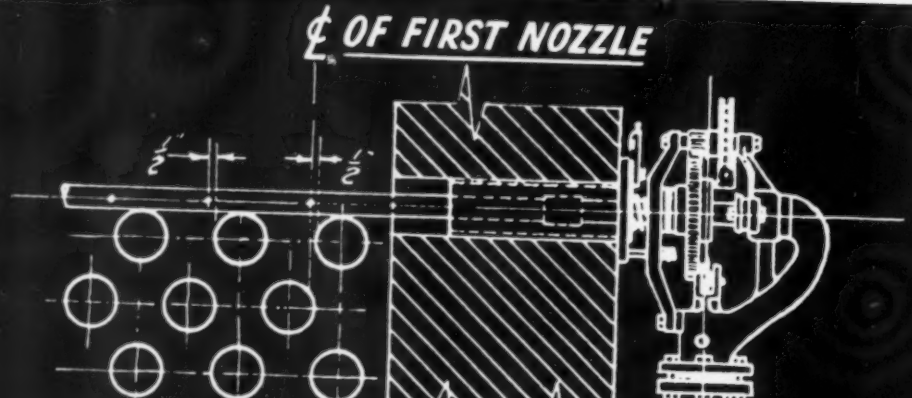
Q-1097

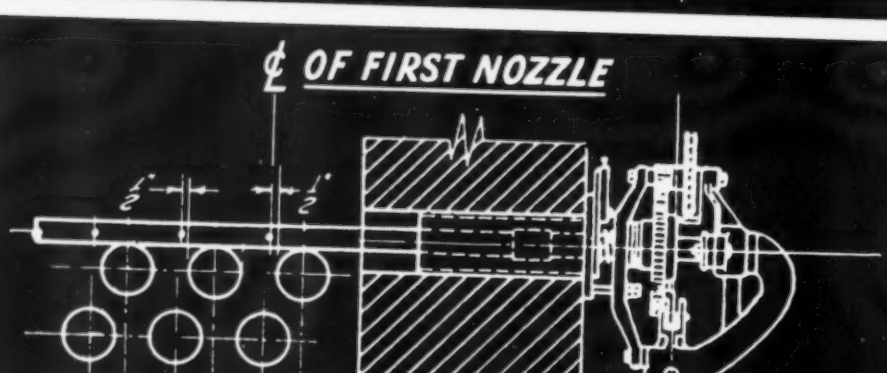
GET MORE out of the SOOT BLOWERS you have

℄ OF FIRST NOZZLE



EVENLY STAGGERED TUBES

℄ OF FIRST NOZZLE



UNEVENLY STAGGERED TUBES

℄ OF NOZZLE IN FIRST NARROW SPACE

UNEVENLY SPACED TUBES

CORRECT NOZZLE SETTING IS NECESSARY TO EFFICIENT BLOWING

Correct setting of nozzles is necessary to efficient boiler cleaning—removal of soot with minimum expenditure of steam.

Each time a boiler is taken out of service, all soot blower elements should be checked for correct nozzle setting. Scoring of tubes usually indicates impingement of steam jets—the nozzles are positioned too close to some of the tubes.

Correct setting is a simple matter. Elements should be adjusted so that the first nozzle is ½-inch away from the far side of the tube nearest the head. Measurements are taken, of course, from the tube row nearest the element.

If it is necessary to move the element ½-inch or less in order to properly line up the nozzles with the tubes, the head can easily be moved in or out by adjusting the nuts on the bracket stud or adjustment sleeve stud. If larger adjustment is necessary, this may be made by cutting off the swivel tube or by putting in a longer one, as the situation requires.

THROW YOUR *Scrap* INTO THE FIGHT

URGENT WAR NEEDS *DEMAND* LONGER BLOWER LIFE

Diamond, in common with many other firms, is meeting heavy war demands. It is not always possible for us to supply new blowers or repair parts as quickly as you need them.

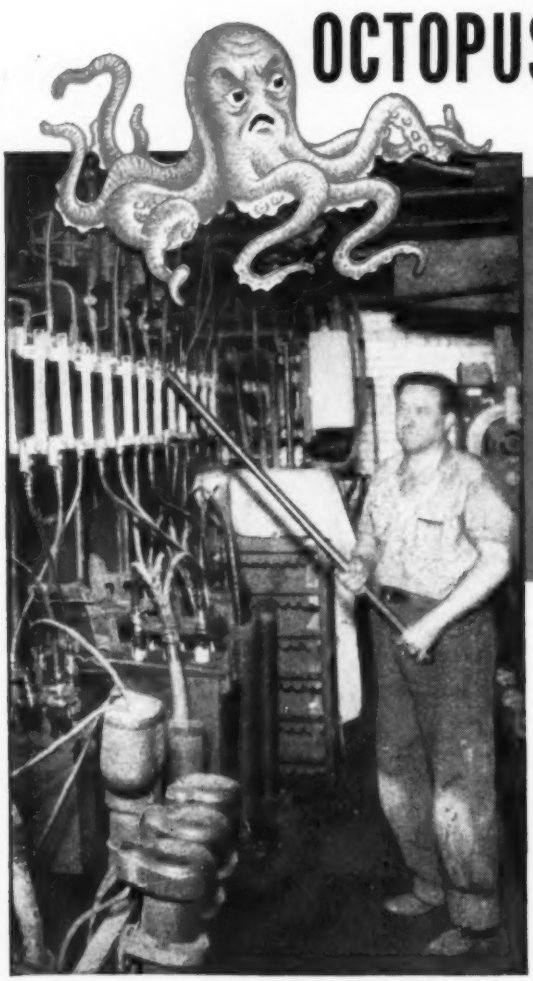
Careful maintenance and repair will prolong the life of the soot blowers you have—defer the time when new blowers or repair parts are needed.

This booklet has been prepared for the purpose of helping you do this. Write for a copy.

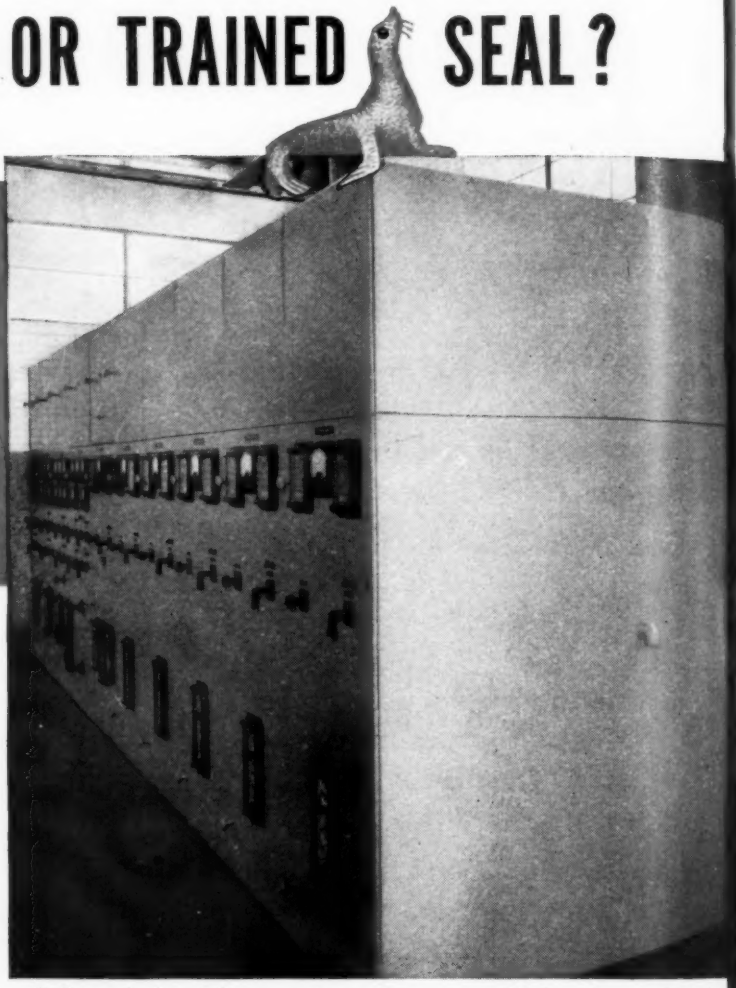
DIAMOND POWER SPECIALTY CORP.
Detroit, Michigan

DIAMOND SPECIALTY LIMITED, Windsor, Ontario

IS YOUR SWITCHGEAR OCTOPUS OR TRAINED SEAL?



Dangerous, "octopus" switchgear like this (above and below) originates as strung-out, open-type switchgear. Too often it is responsible for power interruptions and accidents to personnel.



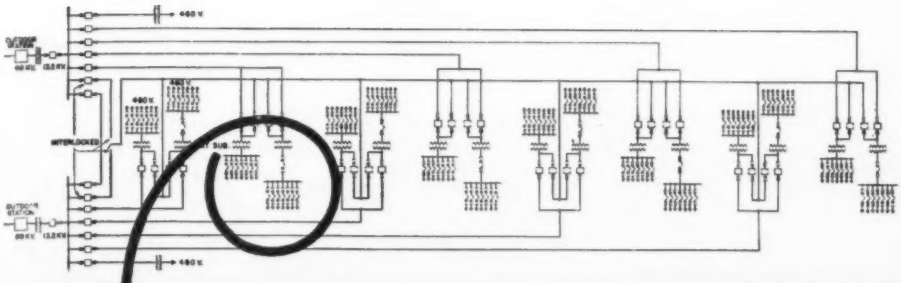
G-E standard switchgear units are factory-assembled and co-ordinated—trained to perform without a hitch. One of the many possible combinations of these standard units should fit your requirements.

PIECEMEAL switchgear installations, which grow through the years to meet increasing demands, tend to become like octopuses—unreliable, and downright dangerous. The practical provision for your present and future requirements is the standard, metal-clad unit of switchgear equipment—dependable, safe, copper-saving, space-saving, and economical both in installation cost and maintenance. The capacity of a modern, co-ordinated metal-clad system, large or small, can be increased easily and safely by adding compact units of standard, safety-enclosed switchgear.

Whether you plan expansion or replacement of your present system, investigate the advantages offered by G-E metal-clad switchgear.

The best investment in the world is in this country's future—
BUY WAR BONDS

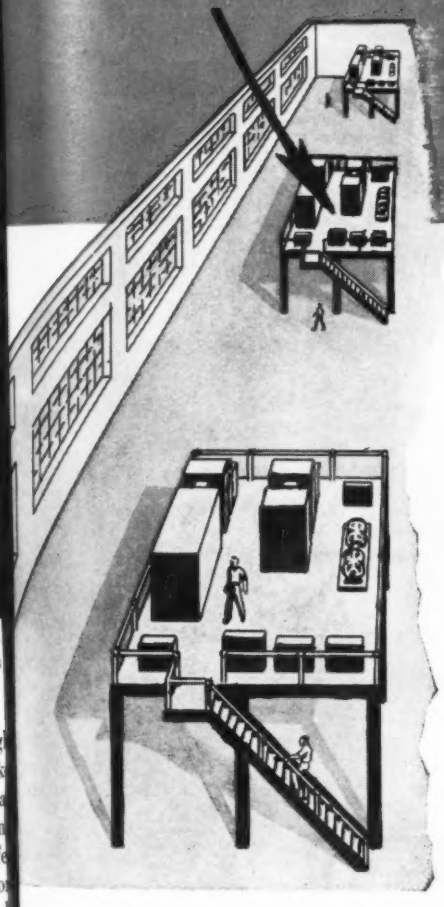
PACKAGE
SWITCHGEA



This installation affords excellent continuity and flexibility of power service, plus good utilization-voltage regulation at practically any part of the plant. Bus-tie metal-clad units interconnect the east and west groups of metal-clad switchgear; therefore, either bus can feed one or both groups of unit substations.

Here's an example of what trained performers, like G-E metal-clad, can do for you

This recent midwest industrial installation saved time, copper, and floor space



The equipment was installed on platforms, which provide space for the speedy removal of the high- or low-voltage breakers for inspection or maintenance. Equipment located here includes: 1. Unit substation for power; 2. Unit substation for lighting; 3. Converter control; 4. Induction converter; 5. Capacitor set; 6. Automatic capacitor control.

WE can't tell you now where this installation was made, but we can say that this system saved 500,000 pounds of vitally needed copper. The selection of 13,200-volt metal-clad switchgear, and corresponding cable, to supply load-center unit substations with relatively high-voltage power, made this saving possible. Also, the use of elevated platforms at the load centers, for the unit substations and other power equipment, put more than 7,000 square feet of main floor area into actual productive use.

You, too, can easily effect important savings of time and material when you choose the right combination of distribution voltage and G-E standard switchgear. Factory-assembled, metal-clad packaged switchgear is installed faster, more easily, at a predictable and low over-all cost.

For your power-distribution switchgear up to 15 kv, and for safety and dependability, get the accepted standard—repetitively manufactured G-E metal-clad switchgear. *General Electric Company, Schenectady, New York.*

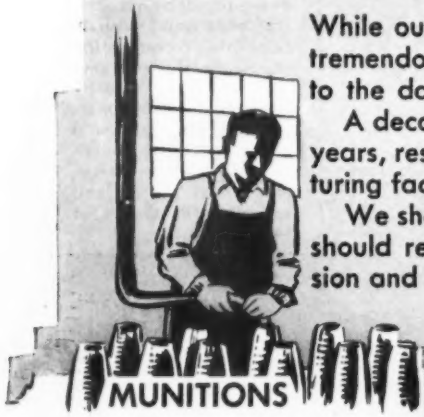
GENERAL ELECTRIC

WHAT *War Production*

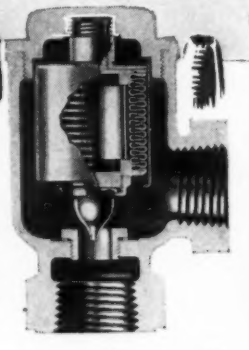
While our plant is striving twenty-four hours every day to keep pace with the tremendous wartime demand for standard Sarco products, we like to look ahead to the days when peace is restored.

A decade of experience and development is being crowded into these war years, resulting in significant improvements in our designs as well as our manufacturing facilities.

We show here a few reasons why Sarco steam traps and temperature control should receive first consideration in connection with your plans for re-conversion and new construction.



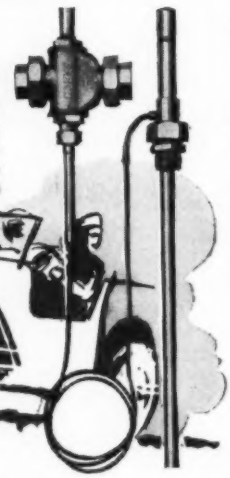
MUNITIONS



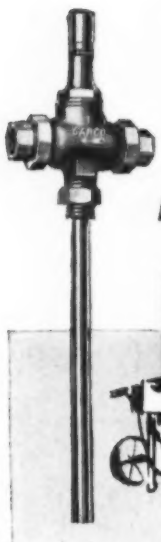
Use of processing equipment in shell loading plants, powder and explosives factories has multiplied many times the demand for the always popular Sarco Thermostatic Steam Trap. Ten years would have been needed to provide the same endurance test for the unique Sarco bellows which makes this trap successful at pressures up to 250 lbs. New facilities for streamlined quantity production will keep it in the lead wherever steam is used for its heat. Catalog No. 250

●

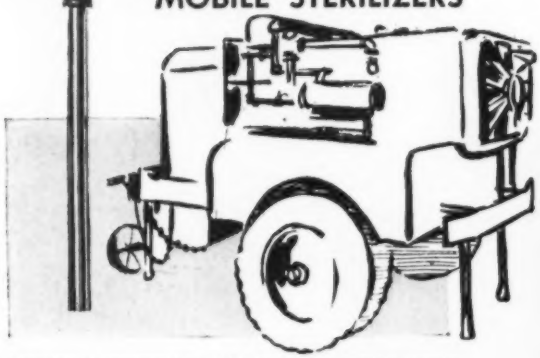
Army garages, repair shops and ground stations are equipped with dynamometer engine testers of the water brake type. Precision temperature control on these is a must. Sarco provided it, using this simple, liquid-filled regulator. Accuracy, compactness, and low cost thus demonstrated will greatly widen its field in the days to come. Catalog No. 600



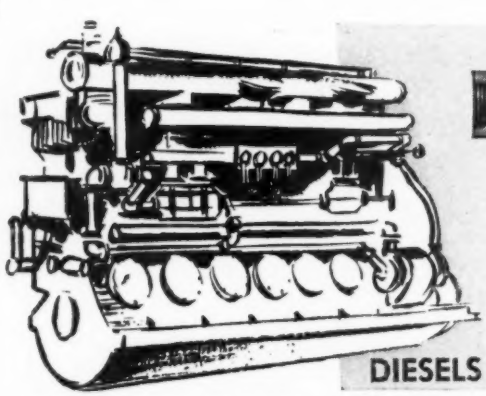
JEEPS



MOBILE STERILIZERS



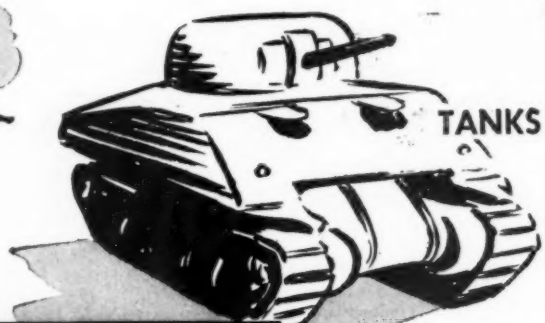
Prominent among the A.E.F's. incomparable equipment for army field hospitals are mobile combination sterilizers and water heaters. Constant water temperature is assured by a Sarco regulator so compact that it literally "melts" into the piping. Quantity production brings them within reach of all users of hot water after the war. Catalog No. 600



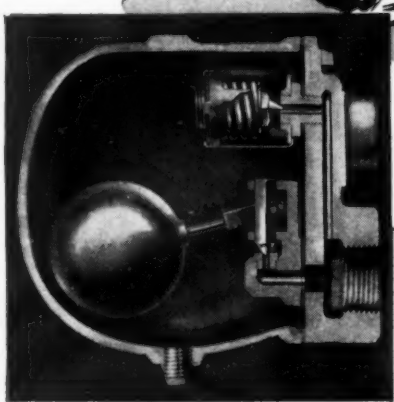
DIESELS

Diesel engines are being used as never before on Navy and merchant vessels of many types both for propulsion and as generator sets.

Hundreds have been equipped with Sarco Water Blenders as jacket water cooling controls. Their faultless performance assures you of tested, proven equipment for every type of cooling circuit on engines, compressors, condensers, stills, etc. Catalog No. 700



TANKS

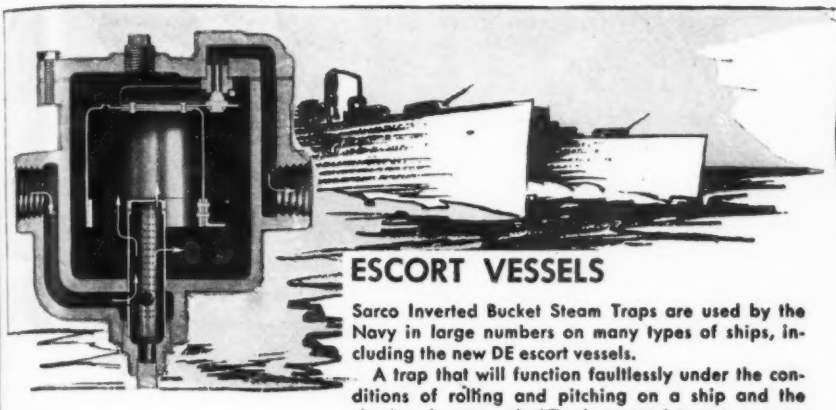


Heating the great aircraft factories, tank arsenals, and ordnance plants has been done largely with unit heaters, with Sarco float-thermostatic steam traps removing the condensate and air rapidly and continuously. It is the favorite trap with heating engineers on mains, risers, and fan units. Catalog No. 450

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.
Represented in Principal Cities

21

IS TEACHING US

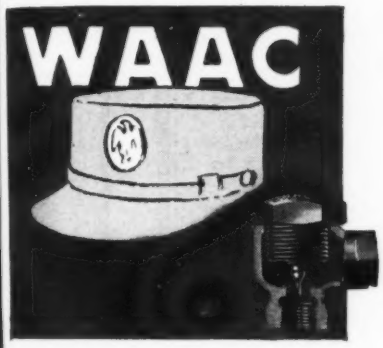


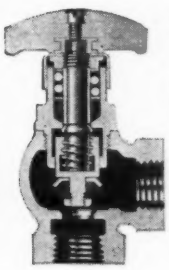
ESCORT VESSELS

Sarco Inverted Bucket Steam Traps are used by the Navy in large numbers on many types of ships, including the new DE escort vessels.

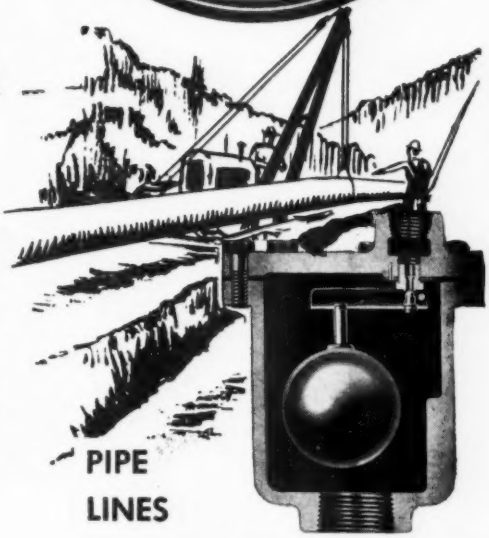
A trap that will function faultlessly under the conditions of rolling and pitching on a ship and the shocks of gun explosions is a good trap to use on the hardest service found on land. Catalog No. 350

AWARDED TO OUR BETHLEHEM PLANT





These simple but efficient radiator traps and supply valves were used in new barracks, cantonments, training stations for all the services. While meeting wartime requirements, they preserve essential features, making for long, trouble-free service in buildings of all types. Catalog No. 160



PIPE LINES

War emergency pipe lines in this country and on the war fronts of the world created a demand for a new type of air vent to eliminate air from lines handling fuel oil or 100 octane gasoline at pressures sometimes as high as 600 p.sq.in.

To its already broad line of vents for steam and water lines, Sarco has added new types which will be welcomed in the chemical and petroleum industries and in power plants. Catalog No. 170

●

A significant war development is hard chromium plating for wearing surfaces, as on dies. Sarco has equipped many of these plating plants with new electric controls for both heating and cooling. Their simplicity and low cost commend them to metal finishers and for many other uses. Catalog No. 1025

KP

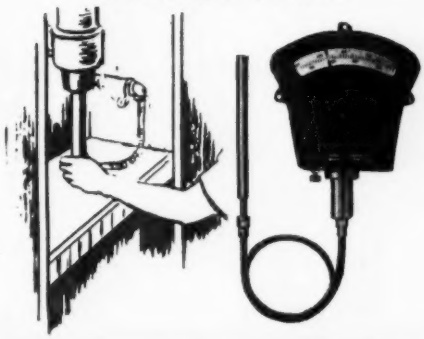
Mechanizing the U. S. Army did not stop with tanks and jeeps. It went right down into the kitchens, where electric dishwashers make short work of what used to be a distasteful task. Sarco designed a combination steam injector and temperature control for these, so simple, foolproof and inexpensive that it will find wide application wherever direct contact water heating is used. Catalog No. 550

V-MAIL FILM

Development of V-Mail film is an assembly-line operation. To make it automatic, Sarco furnished this ingenious mixing valve to provide blended water at exactly the right temperature.

It is ideal not only for film washing, but for group wash basins and wash water in dairies or packing houses, or for process hot water. Catalog No. 800

AIRCRAFT PARTS

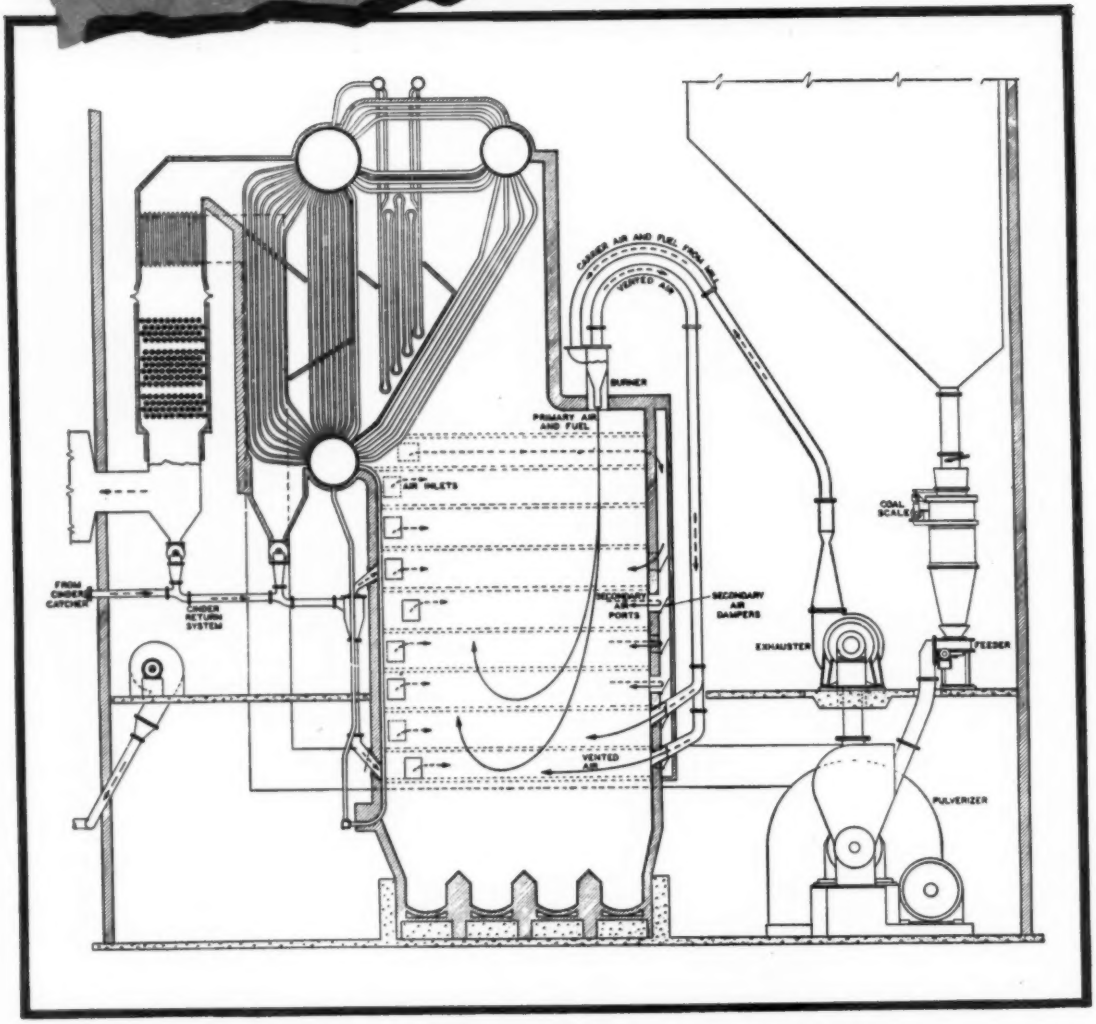


SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

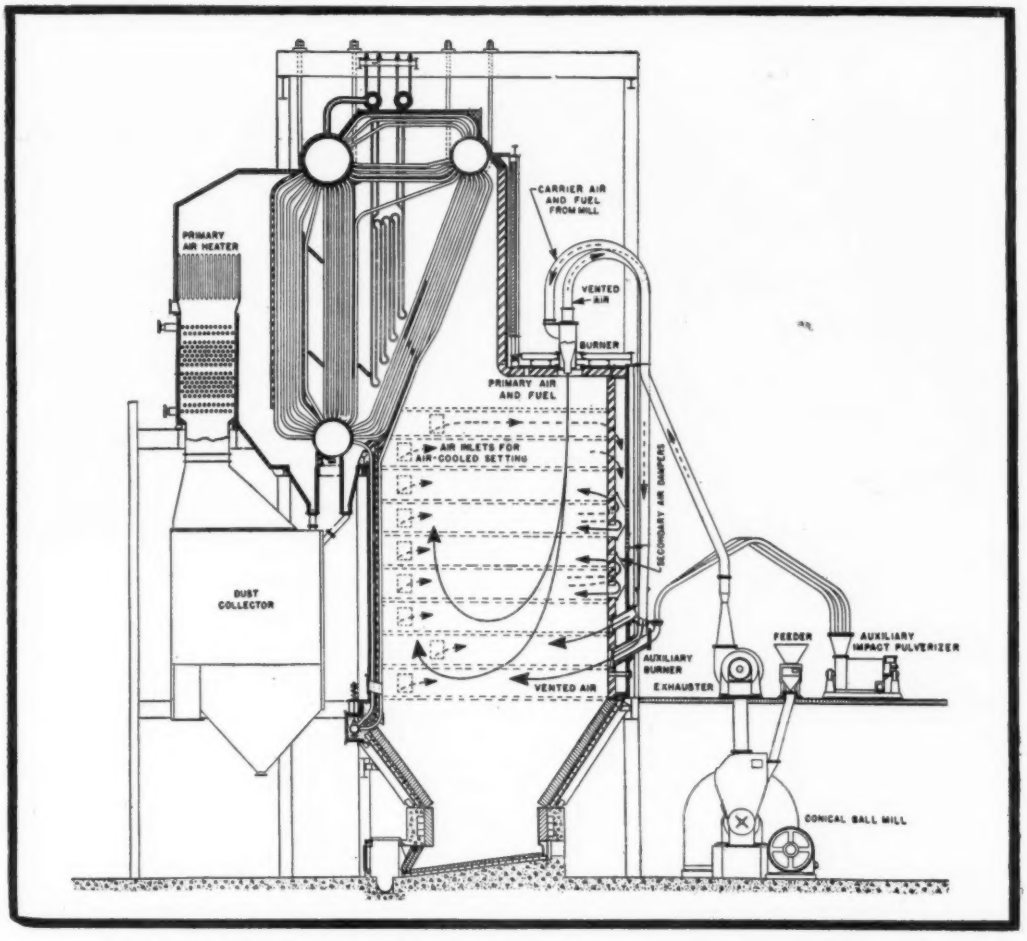
21

20-50% SAVED BURNING ANTHRACITE FINES



This 150,000 lb. per hour steam generator operating on low cost anthracite saves 50% of fuel costs of bituminous required for the same rating.

FW **FOSTER**



Sectional drawing of a 175,000 lb. per hr. high efficiency steam generator which operates on pulverized anthracite. This is one of 2 duplicate units recently installed in a large Eastern paper mill.

● Three steam generators fired with pulverized anthracite have been continuously operated for several years in two prominent boiler plants. Fuel costs of the unit located nearer the anthracite fields are 50% less than if bituminous was fired, while the other installment, situated at greater distance from the mines, effects a corresponding saving of 20%.

For many years "bin" storage systems were necessary adjuncts when burning pulverized anthracite. Fuel characteristics plus limitations in the pulverizing equipment made these complex and expensive applications necessary for safe and continuous operation.

Then came the Foster Wheeler "unit" system for pulverized anthracite. Specially designed pulverizers, burners, furnaces, boilers, superheaters and heat recovery equipment were all integrated into a single unit to pulverize and fire anthracite continuously and as required. "Bin" storage was eliminated and the new installations showed a continuous record of high efficiency, low maintenance and stable furnace conditions under fluctuating loads. The first unit has now pulverized, in highly successful operation, 225,000 tons of anthracite having an average Btu value of 10,500 and average ash content of 15%.

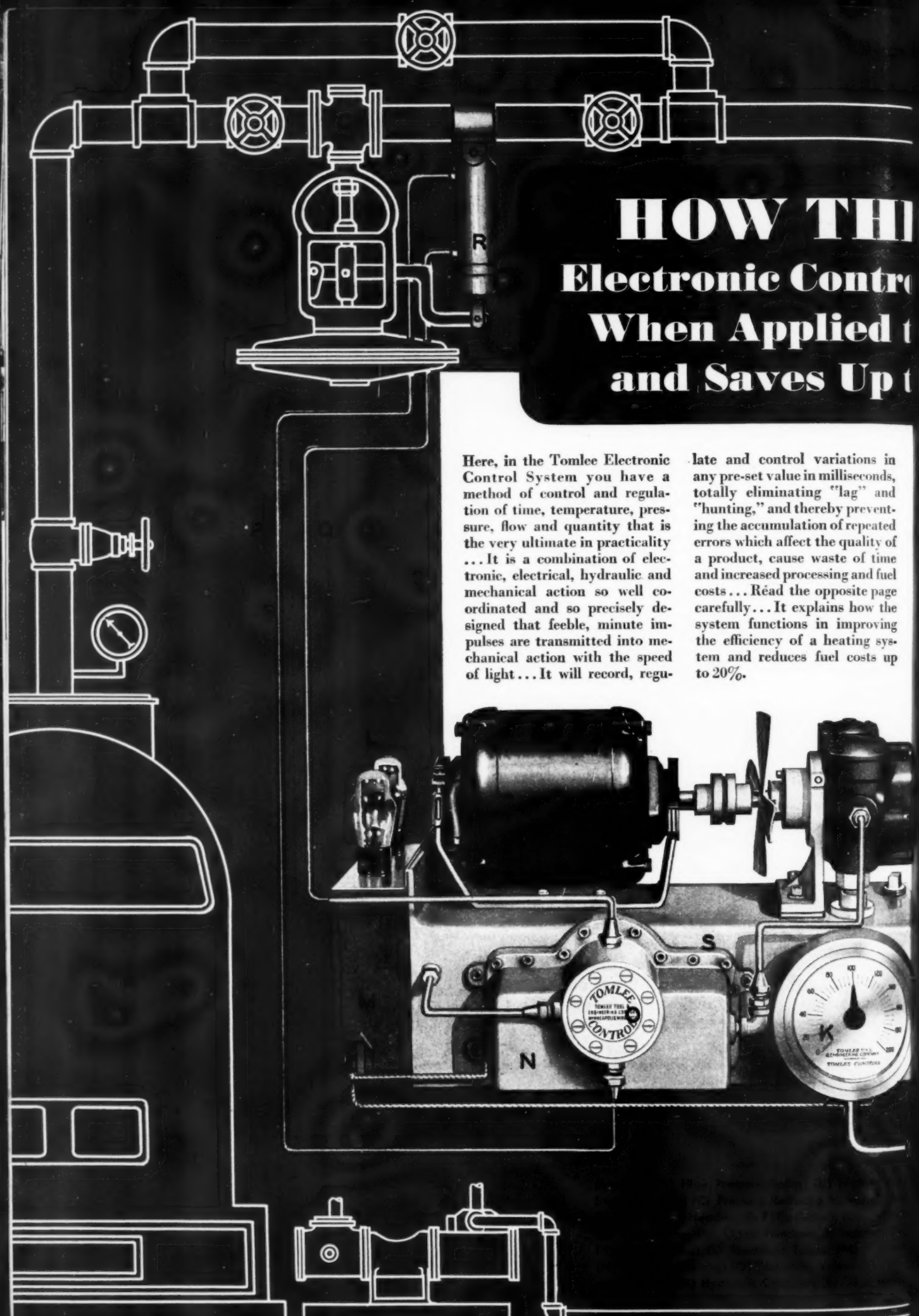
For more than seven years pulverized anthracite has been successfully fired in Foster Wheeler "unit systems". Commercial operating records of the seven units already in service show uniformly economic and efficient performance.

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, N. Y.

WHEELER

HOW THI[T]
Electronic Contr[ol]s
When Applied t[o] H[eat]
and Saves Up t[o] 20%

Here, in the Tomlee Electronic Control System you have a method of control and regulation of time, temperature, pressure, flow and quantity that is the very ultimate in practicality ... It is a combination of electronic, electrical, hydraulic and mechanical action so well coordinated and so precisely designed that feeble, minute impulses are transmitted into mechanical action with the speed of light ... It will record, regulate and control variations in any pre-set value in milliseconds, totally eliminating "lag" and "hunting," and thereby preventing the accumulation of repeated errors which affect the quality of a product, cause waste of time and increased processing and fuel costs ... Réad the opposite page carefully ... It explains how the system functions in improving the efficiency of a heating system and reduces fuel costs up to 20%.



TOMLEE

System Functions
Heating Problem
20% in Fuel Costs

Though not generally acknowledged, excessive fuel costs are frequently traceable to the inefficient utilization of the steam generated rather than to any inefficiencies in the generation of the steam. Steam generated in a high-pressure boiler, reduced through a reducing valve to the low pressure necessary to supply the demand, viz. 5 lbs., is held to exactly that pressure.

As changes in the condensing rate take place in any part of the system, minute changes in pressure also take place. These are instantaneously compensated for in the sequence following.

As minute variations in pressure occur at impulse tube (I), they are transmitted to the extremely sensitive element (K). These minute variations open or close a contact in (K) which operates on only 2 milliamperes of current. This feeble current operates tubes (L) in Flashtron Unit (M), which cause either one of two solenoids located in housing (N) to operate four-way valve (O), which turns a maximum of 11 degrees in either a clockwise or counter-clockwise direction, forcing oil under pressure through hydraulic lines (P) and (Q). This hydraulic pressure operates a piston in hydraulic unit (R) which in turn proportions reducing valve (C), thereby causing the valve to literally float on a cushion of live steam, constantly responsive to the most minute variations in the low-pressure side of the system and maintaining the value pre-set by adjusting sensitive unit (K).

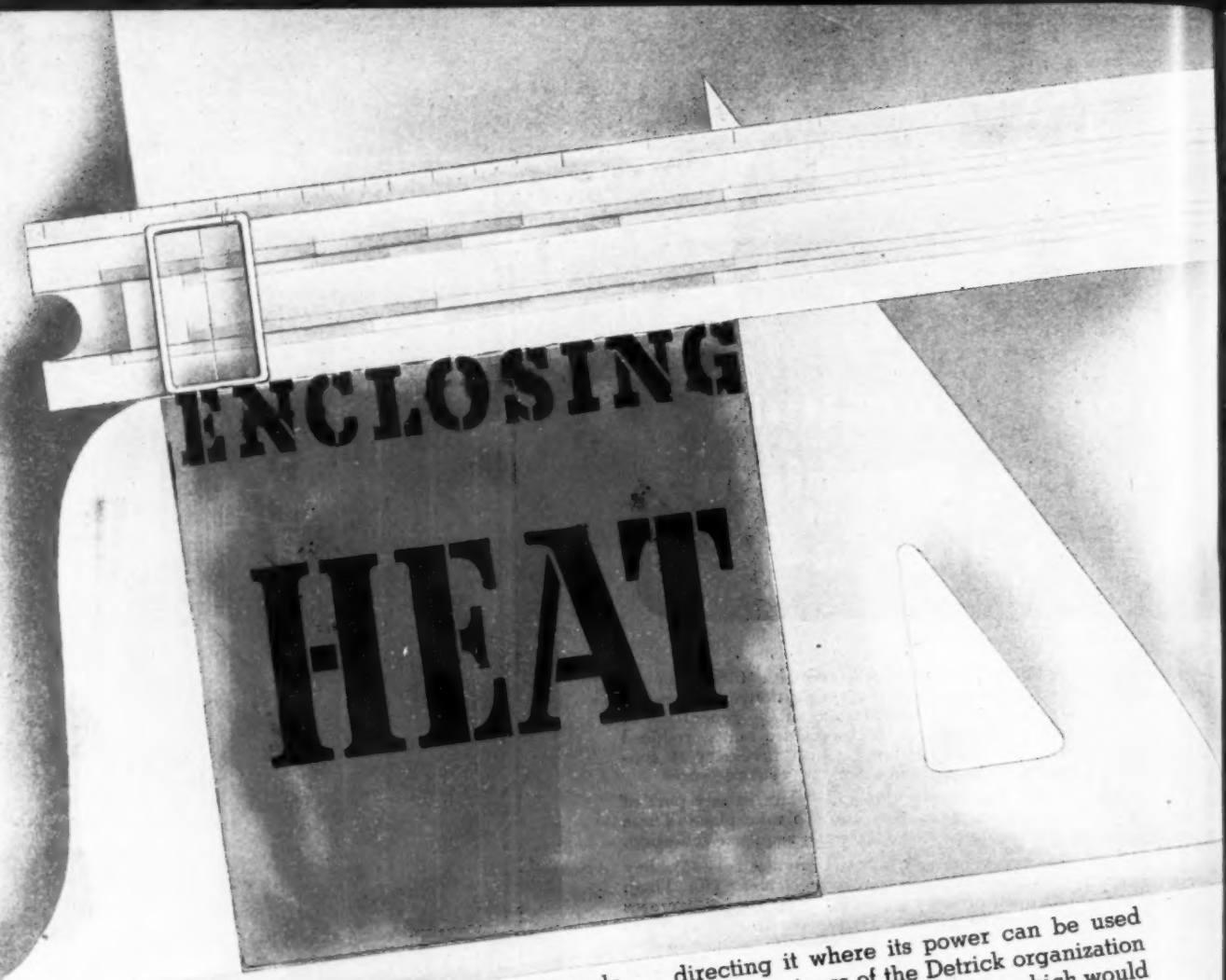
It is obvious that as more rapid condensation takes place in radiator (E) than in radiator (F) and consequently more steam being required in radiator (E), impulse will occur in impulse tube (I); and conversely, when higher condensation in radiator (E) has been compensated for, impulses in tube (I) will immediately act to reduce the volume of steam flowing through reducing valve (C), maintaining the value originally pre-set in sensitive element (K).

While the application described and illustrated here has to do specifically with a heating problem, the advantages of Tomlee Electronic Control System are equally applicable to process control or wherever control and regulation of time, temperature, pressure, quantity or flow is involved.

The Tomlee Electronic Control System is the product of a company highly skilled in the manufacture of precision apparatus.

This company is in a position to make specific recommendations covering the application of this system to practically any control problem. Write for complete information. TOMLEE TOOL & ENGINEERING COMPANY, 253 Third Avenue, South, Minneapolis 15, Minnesota.

TOMLEE



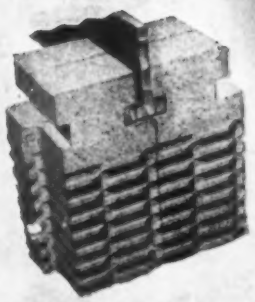
Keeping it within bounds . . . directing it where its power can be used most effectively . . . that has been the business of the Detrick organization for the past 30 years, designing and building walls and arches which would stand a high temperature and severe furnace conditions. As each new problem was presented by industry, Detrick found a practical way to meet it until today thousands of furnaces are serving industry and all of its branches equipped with

DETRICK SUSPENDED ARCHES AND WALLS

It is because of the application of sound engineering principles which Detrick has learned from practical experience, that their arches and walls give such long, economical service. One of these principles is the Detred Tile with treads on all four sides which hold the wall together vertically and horizontally and serve to keep it airtight during its long life. A method of sectionally supporting walls, so that the load is transferred from the tile to metal supports, also contributes to the economy in maintenance.

There is a Detrick construction especially suited for each type of furnace —for steam boilers, for oil heaters, for steel heating furnaces, etc. Each has its own problems which are met by a type of Detrick construction.

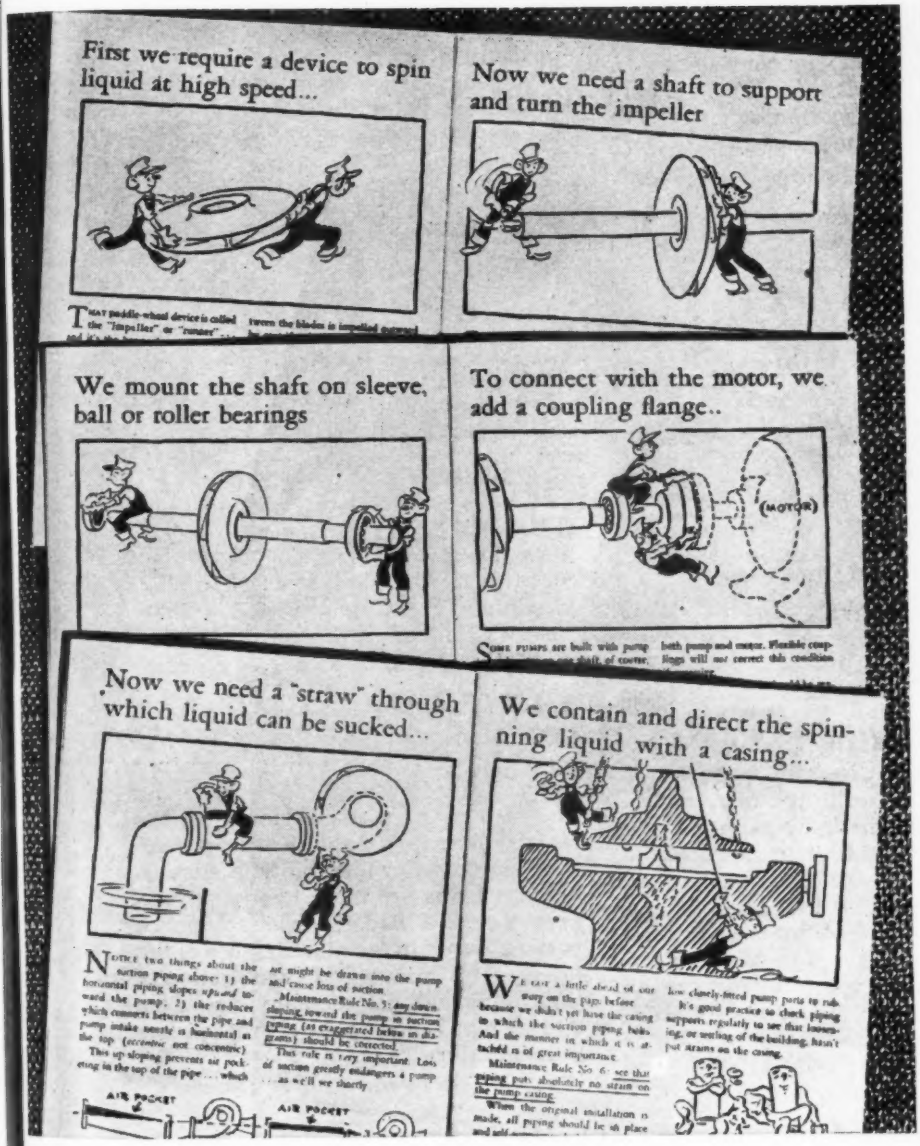
The results of these thirty years of experience have been gathered together in what is practically a textbook on the subject of enclosing heat. With charts, photographs, drawings and illustrations the engineer can bring himself up to date on this important subject. If you have a furnace problem, now, or one in the future we shall be glad to send you a copy of this booklet on request. Ask for DETRICK FURNACE ENCLOSURES



DETRICK
FURNACE ENCLOSURES

M. H. DETRICK COMPANY
140 SO. DEARBORN ST.
CHICAGO, ILLINOIS

Let's Build a Pump!


First we require a device to spin liquid at high speed...
Now we need a shaft to support and turn the impeller
We mount the shaft on sleeve, ball or roller bearings
To connect with the motor, we add a coupling flange..
(MOTOR)
Now we need a "straw" through which liquid can be sucked...
We contain and direct the spinning liquid with a casing...
AIR POCKET
AIR POCKET

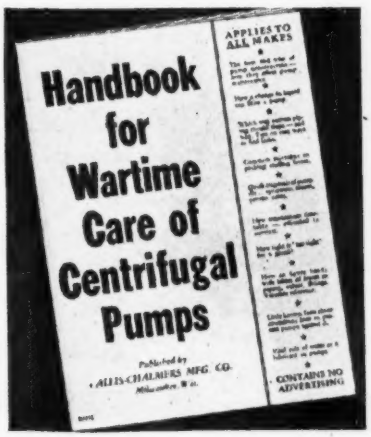
When you do need new pumps — look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps... the famous "Electrifugal" ... and all types for every purpose.

ALLIS-CHALMERS
MILWAUKEE

WE WORK FOR VICTORY — WE PLAN FOR PEACE

A PUMP IS BUILT— STEP BY STEP— IN A-C'S NEW PUMP MAINTENANCE GUIDE. AS EACH NEW PART IS ADDED, WE SEE WHAT IT DOES, HOW IT DOES IT, HOW IT MUST BE CARED FOR.

WITH MOST PUMPS today doing *3 and 4 times* their normal work, they need the finer kind of care set forth in Allis-Chalmers' new "Handbook for Wartime Care of Centrifugal Pumps". Every executive, engineer and maintenance man should have a copy of this informative book in his technical library!



This book applies to *all* makes of pumps — contains no advertising! Contents include: new preventive maintenance tips; *war* timetable for pump care; valuable tables, etc. Tear out coupon and send in now for your *free* copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee 1, Wisconsin

Gentlemen:
Yes, I would like to receive, *free of charge*, a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name)

(Title)

(Company)

(Street Address)

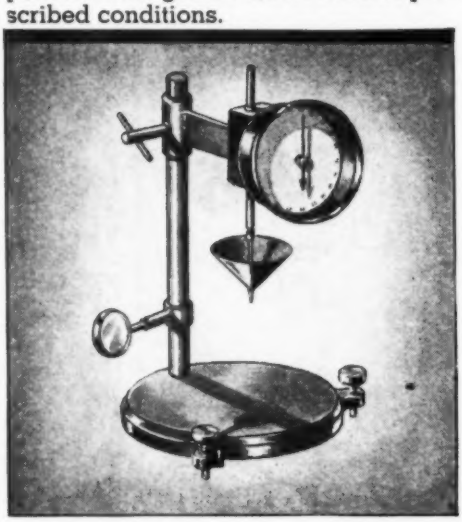
(City and State)

A 1653-9

PENETRATION

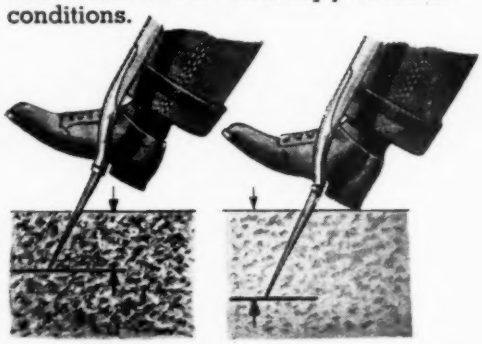
TIDEWATER LUBRICANIA

DEFINITION: The consistency or hardness of lubricating greases is generally expressed by the depth to which a standardized cone-shaped weight will penetrate the grease under definite prescribed conditions.



PENETRATION TEST: Following a carefully prescribed procedure the grease is brought to a temperature of 77°F. and the tip of the penetrometer cone is lowered until it just touches the surface of the grease. The cone is then quickly released for five seconds and the depth of travel of the cone is carefully noted. The average of five such tests at different points of the grease surface, measured in tenths of a millimeter, is reported as the Penetration or Consistency of the grease at 77°F.

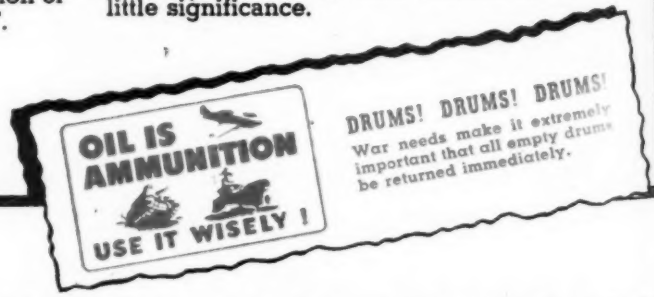
If the grease was not worked before the test, it is reported as the "unworked" consistency. If the "worked" consistency is to be determined, the sample is first worked under carefully prescribed conditions.

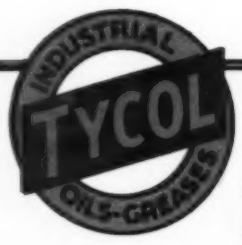


EXAMPLES:

	A.S.T.M. "Worked" Consistency (77° F.)
Soft (No. 1) Cup Grease	310-340
Medium (No. 3) Cup Grease	220-250
Heavy (No. 4) Cup Grease	175-205
Hard (No. 6) Cup Grease	85-115

SIGNIFICANCE: The "worked" penetration is an indication of the tendency of the grease to leak or drip from a bearing, or its ability to flow under pressure in feed lines. However, the resistance to flow through narrow bearing clearances or the ability to support bearing loads are more nearly proportionate to the viscosity characteristics of the oil used in the manufacture of the grease. The "unworked" penetration of greases is subject to many variables and except for very hard greases has little significance.


OIL IS AMMUNITION
USE IT WISELY !
DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.



SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE

TYCOL

*This is the 7th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

Tycol greases are scientifically compounded for all lubricating purposes, from textile spindles to steel rolling mills. Tycol greases when used for the recommended purpose afford maximum lubrication with minimum friction and leakage.

Whatever you need — whether it be a lubricating oil or grease — Tycol lubricants provide complete protection at low cost. Let a Tide Water engineer help you select the lubricant best suited to your job.

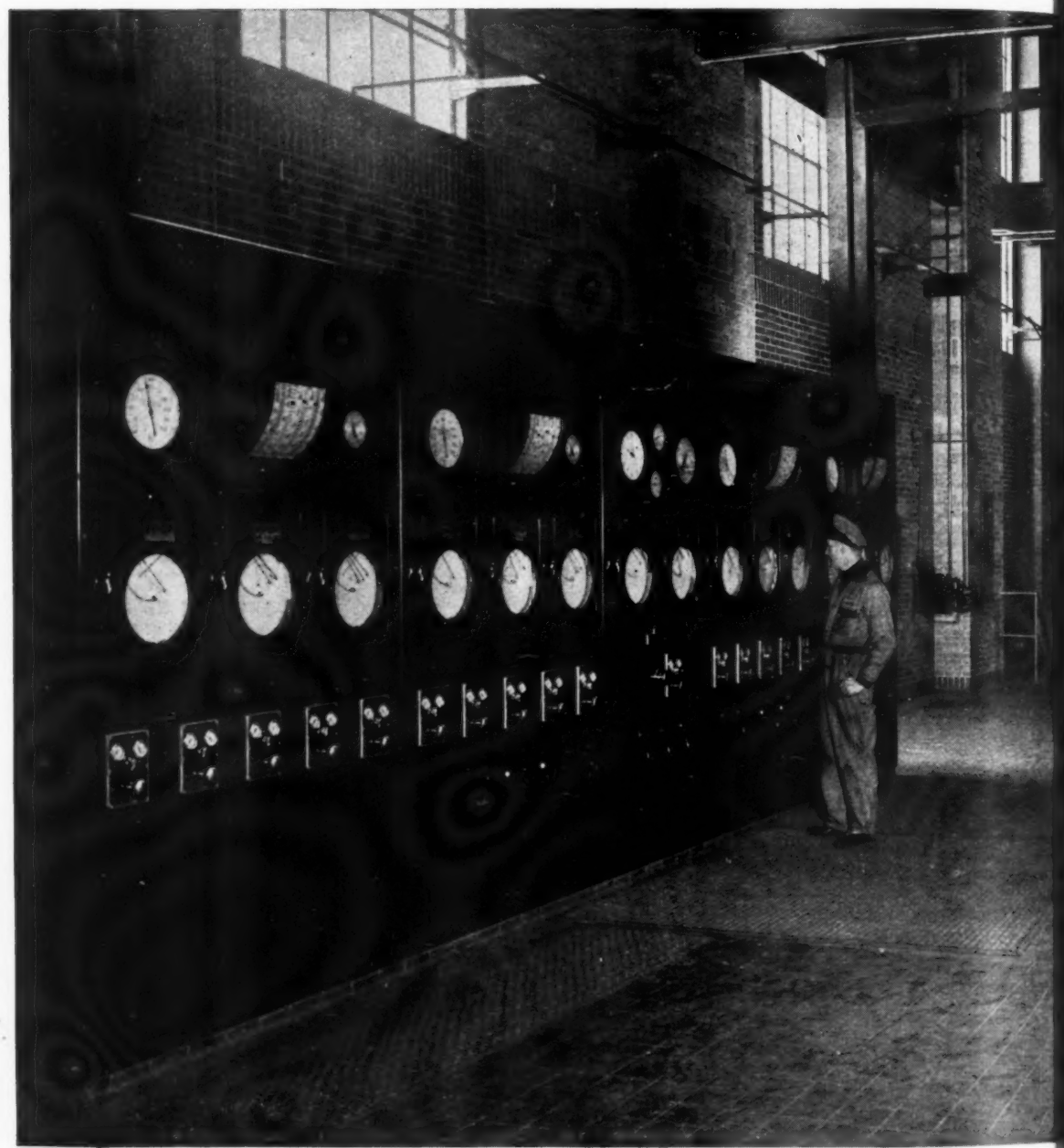
TIDE WATER
ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL
Eastern Division: 17 Battery Place, New York 4, N. Y.
Principal Branch Offices:
Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

INDUSTRIAL LUBRICANTS

Boiler Control eases

Continuity of Operation, Fue
Can Be Maintained While



BAILEY METERS

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

Manpower Shortage

Economy and Maximum Safety Training New Operators

★ Power Engineers are now faced with the difficult task of operating at full capacity and high efficiency in spite of a serious lack of experienced manpower. Under these conditions complete boiler control is the power engineer's best friend and most trusted lieutenant. It stays on the job continuously and is a valuable aid in carrying on normal operation while new manpower is being "broken in".

It maintains continuity of operation, fuel economy, and maximum safety equally well with experienced or inexperienced operators.

Bailey Boiler Control is a truly complete system. In addition to the usual functions of maintaining steam pressure, regulating furnace draft, and distributing load among boilers, it offers these additional values:

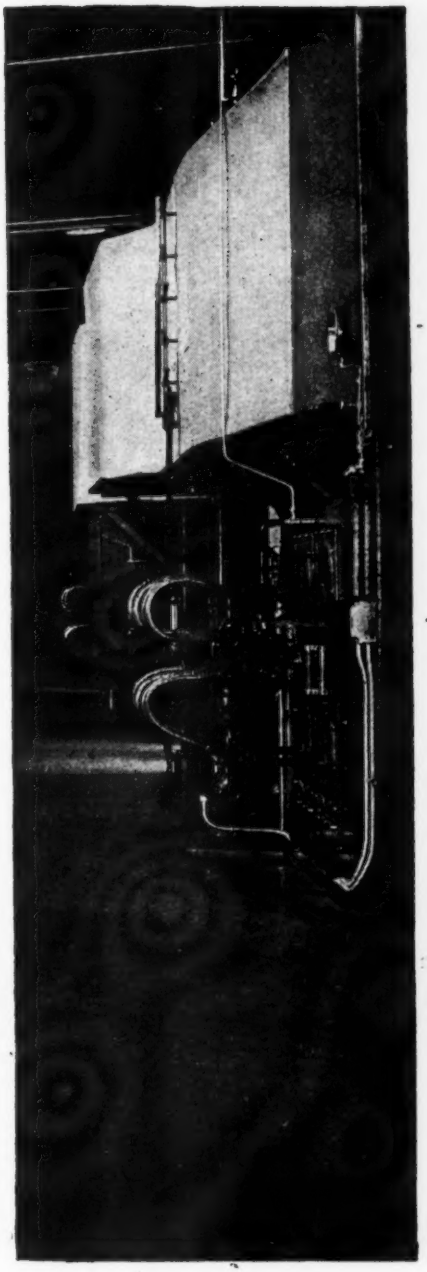
1. An automatic readjustment of the fuel—air ratio which functions continuously to insure economical combustion and safe furnace temperatures day after day.

2. No control system is better than its metering device—in the Bailey System, control impulses are originated by standard Bailey Meters.

3. Provision is made for the protection of steam generating equipment by the addition of purge interlocks, fan failure interlocks and flame detectors.

A helpful discussion on the use of boiler control for war time power plant operation is contained in Bulletin No. 16, "How To Safely Stretch Steaming Capacity." A copy will be mailed to you upon request.

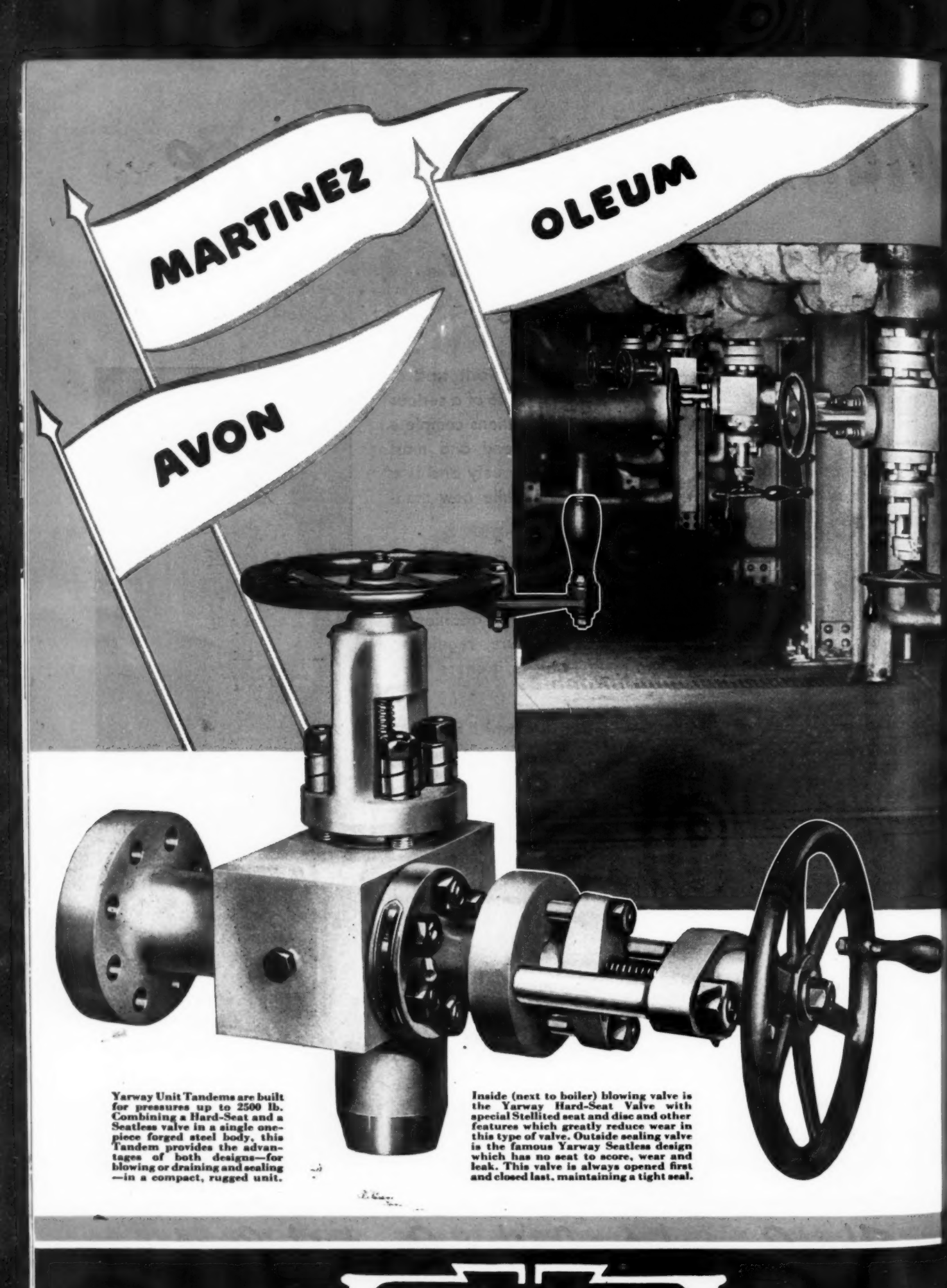
A-86



BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

. . . The Complete Boiler Control System

NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

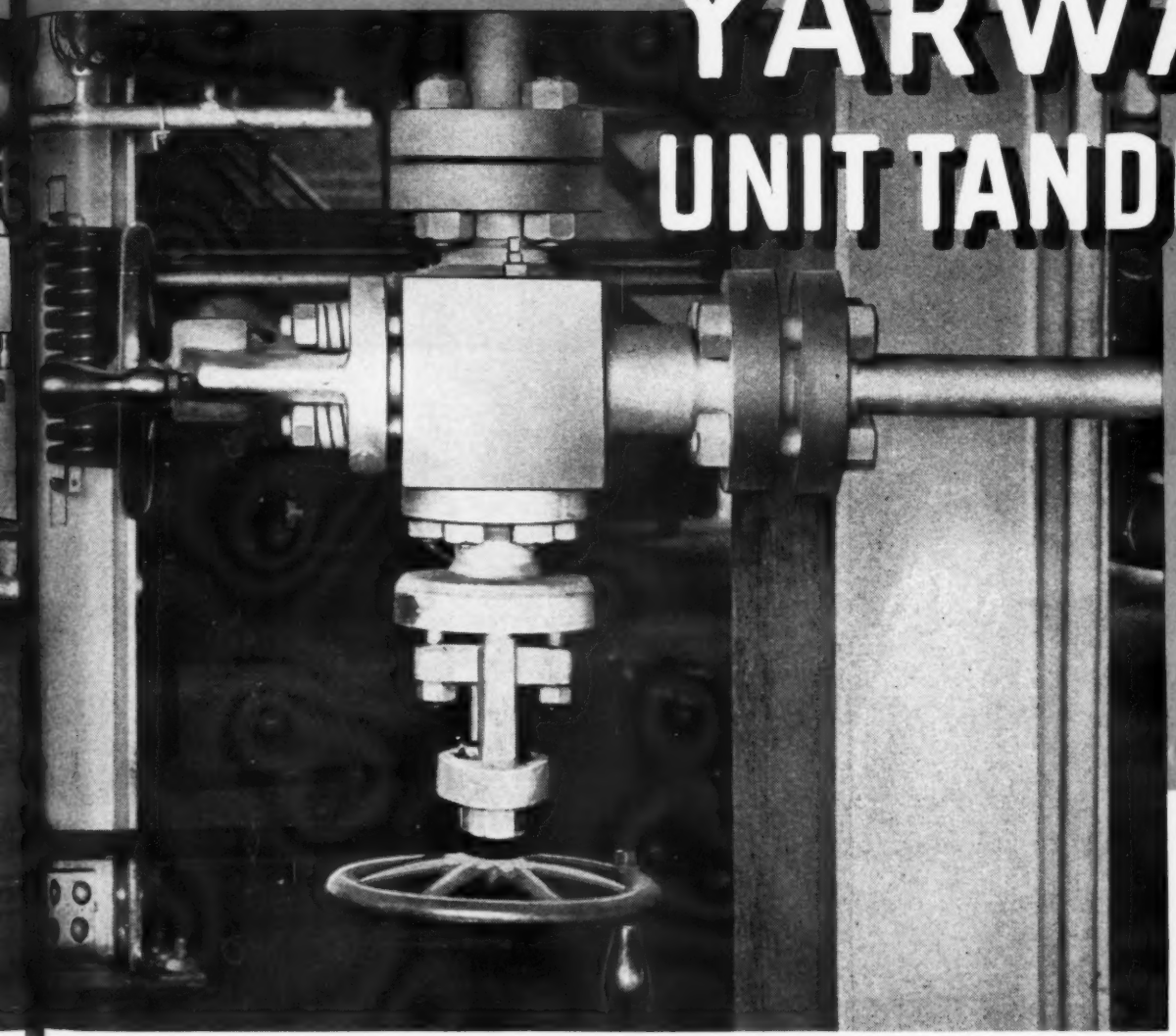


Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or draining and sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve with special Stellited seat and disc and other features which greatly reduce wear in this type of valve. Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last, maintaining a tight seal.

YARWAY

All Three of These Pacific Gas & Electric Co. High Pressure Stations Completely Equipped with YARWAY UNIT TANDEMS



THREE more in the long list of modern, high pressure generating stations to select Yarway Unit Tandem Blow-Off Valves — the 1500 lb Martinez, Avon and Oleum Stations of the Pacific Gas and Electric Co.

The illustration shows five of the six Yarway Unit Tandems in use on water wall drains and boiler blow down lines at Martinez Station. All together, there are 24 High Pressure Yarway Unit Tandems in use in the three plants. 80% of the leading high pressure utility and industrial plants have selected Yarway Tandem Blow-Off Valves.

Years of service have proved the sound design and metallurgy of these valves for blowing down or draining and sealing. Such records as—"3000 blows at pressures of more than 1300 psi without a single replacement of parts or repairs of any nature"—have made the Yarway Unit Tandem the outstanding preference for high pressure service today

What are your draining and blow down requirements? Write for Catalog. Section B-431 for pressures up to 2500 lb; section B-422 for lower pressures.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

BLOW-OFF VALVES

Never Before - A Motor L

You've never seen a motor like this new Fairbanks-Morse Motor, because never before have so much stamina, versatility, and protection been put inside of one motor housing!

CHECK THESE POINTS:

✓ **1.** *40° C. Motor.*

✓ **2.** *Protected frame.*

✓ **3.** *Conduit box* with features that give new meaning to "adaptable," "convenient," and "handy."

✓ **4.** Famous Fairbanks-Morse *COPPERSPUN* Rotor—the *ONLY* rotor centrifugally cast in *ONE* piece and of *COPPER.*

If you are buying motors now but want them to be up-to-date for postwar production, see this motor demonstrated. *There's no other way to appreciate how much more* it offers you! Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago, Ill.

FAIRBANKS-MORSE

DIESEL ENGINES
PUMPS
MOTORS
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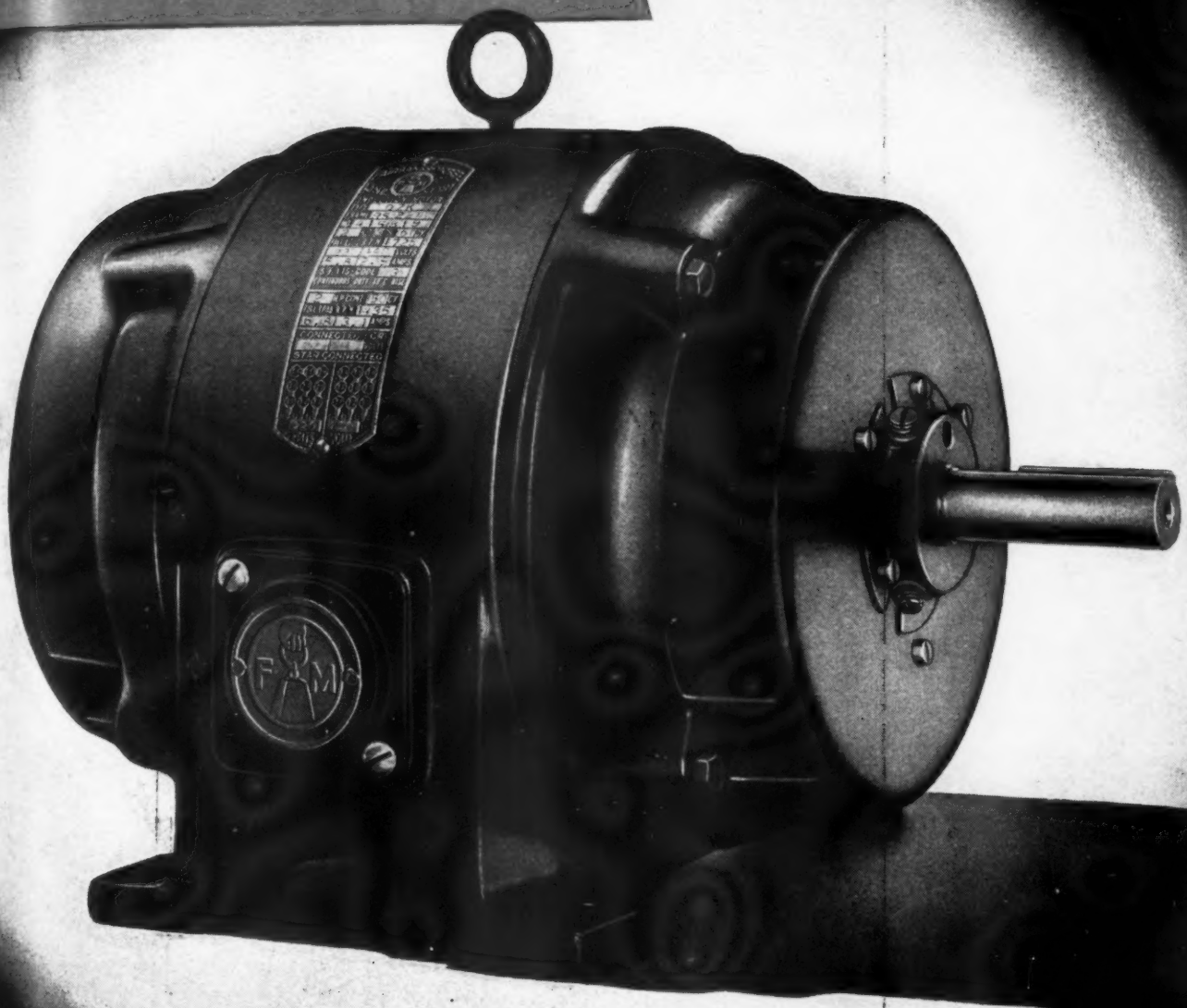
WATER SYSTEMS
SCALES
STOKERS
FARM EQUIPMENT
RAILROAD EQUIPMENT

F M

Motors

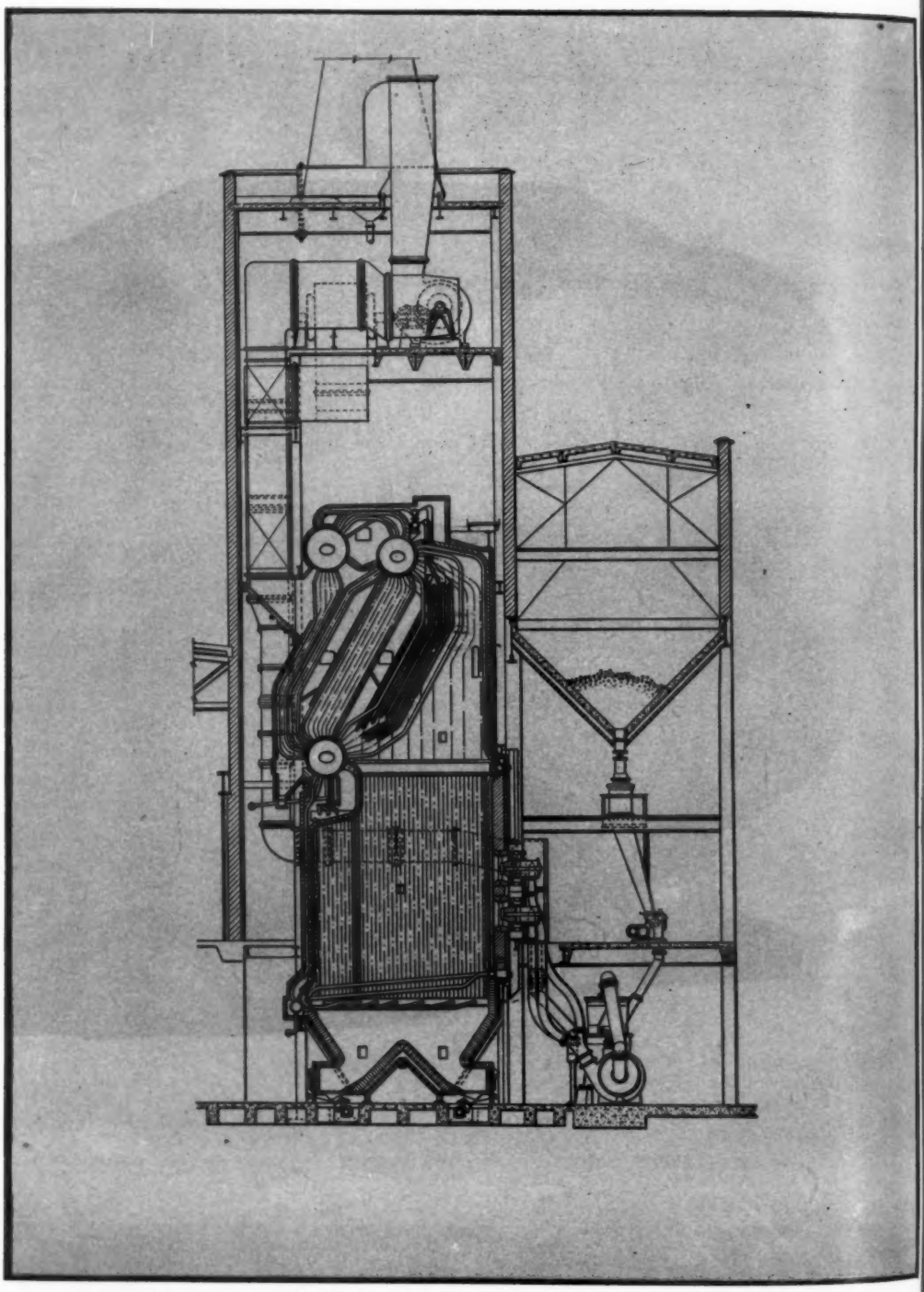
Like This



WITH *Copperspun* ROTOR

Buy War Bonds

FULL YEAR OF CONTINUOUS



The performance record described at the right was accomplished by the C-E Unit illustrated above. It is one of two duplicate units installed in 1937. Maximum continuous capacity — 125,000 lbs. of steam per hr. Design pressure — 900 psi. Total steam temperature — 750 F.

WARTIME STEAM GENERATION

Money-saving C-E installation handles widely fluctuating loads without interruption

Here's another demonstration of the contribution being made by C-E steam generating equipment to the success of the war. It's a record from the plant of one of the most prominent names in radio where a huge volume of production is entirely directed toward war purposes.

The steam plant installation consists of two C-E Units which were first placed in service nearly six years ago. Besides a highly satisfactory performance in meeting steam demands, the C-E installation is credited with savings of more than $125,000.00 per year as compared with the equipment which it replaced.

But the past year of wartime service emphasizes the importance of the extra performance obtainable from steam generating equipment designed and built to the highest standards. For example, one of the C-E Units has just completed a full year of continuous service during which it was "on the line" 24 hours a day, seven days a week. Even then it was removed from service only for a scheduled inspection and cleaning. During the year, it handled steam output fluctuating between light, summer Sunday loads of 5,000 lb of steam to maximum peaks of 150,000 lb of steam, though the unit is designed for a maximum capacity of 125,000 lb of steam per hour. The average weekday load was substantial, approximately 90,000 lb per hour.

This performance parallels that of many war-time industrial and utility installations of C-E Steam Generating Units and is a reflection of the high standards which influence their original design and construction.

COMBUSTION ENGINEERING

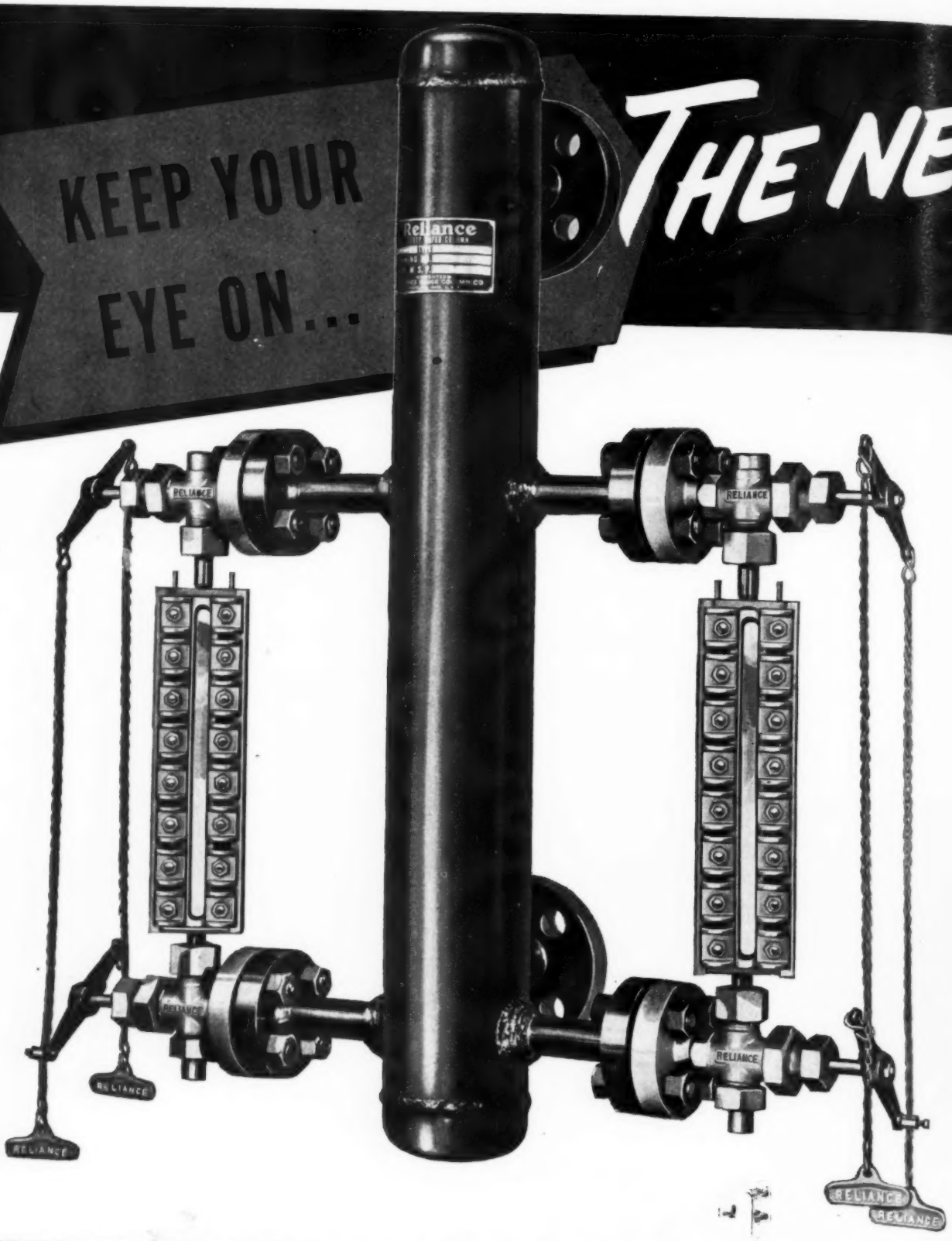
200 MADISON AVENUE, NEW YORK 16, N. Y.

A-758

Canadian Associates: COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver

KEEP YOUR EYE ON...

THE NEW



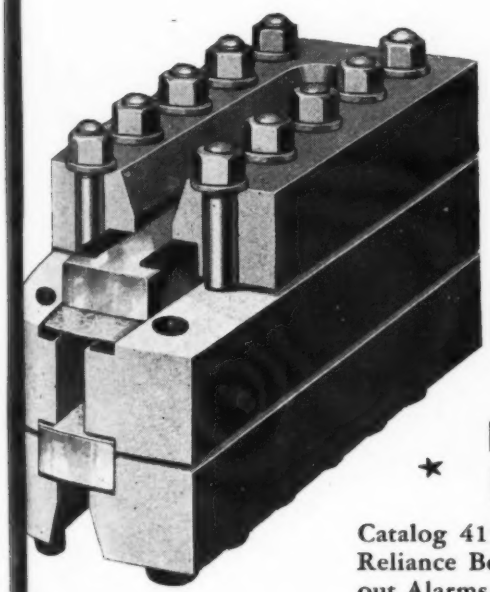
Since 1884

Reliance

POWER TECHNIQUES

Meet high pressures with Reliance Equipment built for high pressure safety

YOU HEAR of new power techniques, higher working steam pressures, greater mastery of the science of converting basic elements into industry-moving force. Almost every step calls for some adjustment in equipment, such as new ruggedness and safety features in boiler water columns and water gages. The latest Code requirement, for instance, is that boilers operating above 400 p.s.i. be equipped with *two water gages.* . . . Reliance keeps abreast of all boiler safety device requirements — supplies standard and tailor-made equipment for any working steam pressure. For example — twin-gage Water Columns . . . heavy duty Gage Valves . . . shatter-proof mica-protected Flat Glass Gage Inserts — besides a comprehensive line of devices for supervision of water levels on lower pressures.



★ New High Pressure Equipment Catalog ★

Catalog 415, newly published, fully describes Reliance Boiler Alarms, Water Columns without Alarms and complete Gage Equipment for higher pressures. . . . Write for your copy — on company letterhead.

BOILER SAFETY DEVICES

THE RELIANCE GAUGE COLUMN CO.
Cleveland, Ohio

B. t. u. Savers

CO_2 METERS

An Automatic Orsat—For Checking Combustion Efficiency

For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. Less than this amount indicates an excess of combustion air, causing high stack loss. The CO_2 meter is the only method of accurately determining combustion efficiency.

WRITE FOR DATA BOOK No. 403

RECORDING THERMOMETE

Remote Reading—Single and Multiple Pen

Republic thermomet are available for reco ing temperature of fl gas, temperatures in va or tanks either open o closed and under pres sure, temperatures in pipe lines, refrigeration systems, ovens, kilns or ducts. For unusual conditions, special bulbs are furnished of corrosion resisting metal or with a protective coating.

WRITE FOR DATA BOOK No. 210

FLOW METERS

Electrical Remote Reading Type

Republic electrical type flow meters are available for measuring the flow of all types of liquids and gases. Meter bodies are built for metering fluids at line pressures up to 10,000 lb. per sq. in. and for all ranges of differential pressure. The reading instruments — indicator, recorder and integrator — are of the remote reading type.

WRITE FOR DATA BOOK No. 701

REGULATORS

Pressure—Flow—Speed—Level—Ratio

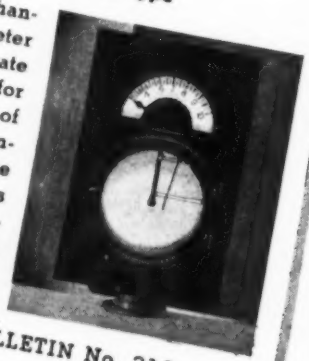
Republic hydraulic or pneumatic type regulators are supplied for the automatic control of pressure, rate of flow, speed of rotation, level of a liquid or the proportioning of two pressures, flows, etc., in a fixed ratio by mechanically operating a valve, damper, rheostat or various types of variable speed transmissions.

WRITE FOR DATA BOOK No. S-13

FLOW METERS

Mechanical Float Type

The Republic mechanical float type meter is a simple, accurate metering device for measuring the flow of steam, water, gas, compressed air, oil, brine and other fluids. It has been designed primarily for installations where remote registration is not required.

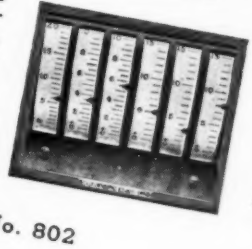


WRITE FOR BULLETIN No. 312

DRAFT AND PRESSURE INSTRUMENTS

Diaphragm Actuated Any Number and Combination

Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic dry-bellows type indicators and recorders are supplied for all ranges encountered in furnace operation in any desired combination.



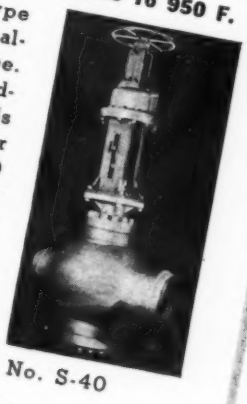
WRITE FOR BULLETIN No. 802

that will help you stretch wartime plant capacity

PRESSURE REDUCING AND REGULATING VALVES

ssure To 2500 lb.—Temperatures To 950 F.

Republic turbine type alves are of the gradual- pening, high-lift type. ey are built in accord- ce with A.S.A. standards d can be supplied for pressures up to 2500 per sq. in. and for peratures up to 950 F for any specified ca- y. Republic valves egulate down to 2% ximum flow.

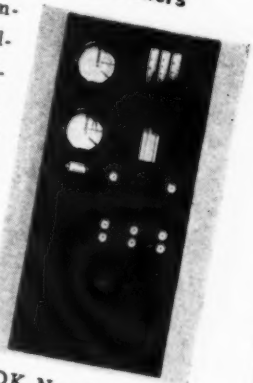


ITE FOR BULLETIN No. S-40

COMBUSTION CONTROL

For All Sizes and Types of Boilers

Republic automatic combustion control is available for all sizes of boilers, all types of fuel firing, all load conditions and any arrangement of draft equipment. It maintains constant steam pressure, highest combustion efficiency, desired load division, constant furnace draft.



WRITE FOR DATA BOOK No. S-21

DESUPERHEATERS

Built To Meet Your Specific Requirements

Whatever your plant conditions, you n obtain the necessary operating xibility and accurate regulation steam temperature with rugged, ply-controlled Republic desu- eaters. These are of the venturi with ratio or ratio-tank control, team atomizing type and the anical atomizing type.

RITE FOR DATA BOOK No. S-35

BOILER METERS

Record Steam Flow-Air Flow

The Republic Boiler Meter records simultaneously on one chart the steam flow from the boiler and the rate of air flow to the furnace for combustion. The air flow pen is adjusted to record coincident with the steam flow pen when the furnace is receiving the proper amount of air for maximum combustion efficiency.

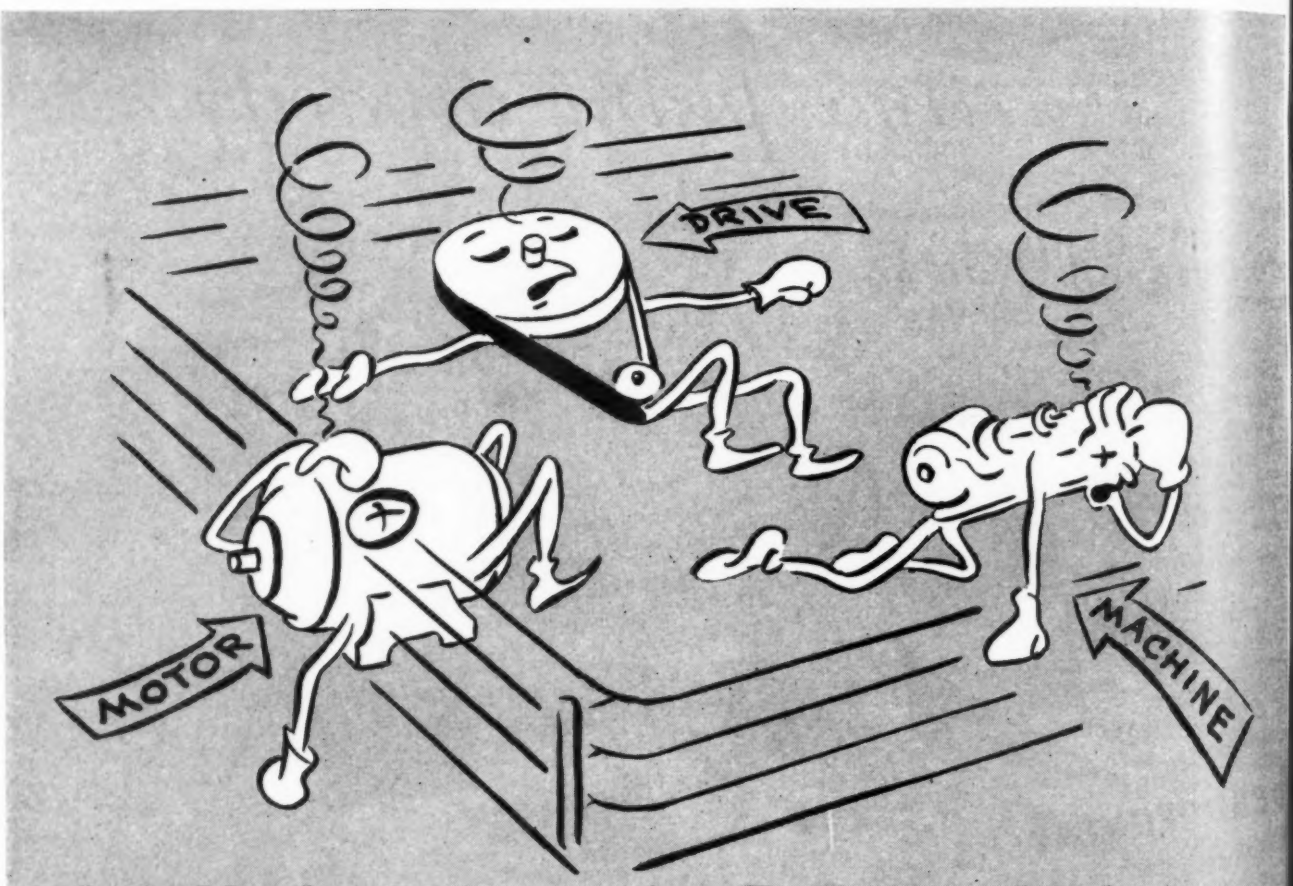
WRITE FOR BULLETIN No. 420

REPUBLIC INSTRUMENTS AND CONTROLS

epublic Flow Meters Co.

2 Diversey Parkway · Chicago 47, Illinois

STOP THIS FIGHT!



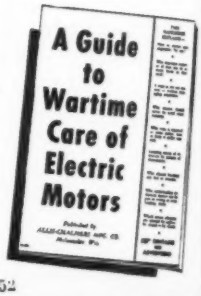
Once Misalignment starts 'em Fighting each other . . . the only Question is: Which will go First?

SPRUNG OR BROKEN shafts, burned-out bearings, overload failure—are cases of motor damage commonly caused by Misalignment. And the damage can occur in drive or driven machine, too. For when these elements are assembled in incorrect geometry, bending, breaking or excessive wear must result. *Something has to "give!"*

Picture above is from Allis-Chalmers' new "Guide to Wartime Care of Electric Motors" . . . which takes a fresh look at Misalignment *and the 8 other main enemies of motor life!*

Over 100,000 copies of this valuable new book are already in use by armed forces and industry. Applies to all makes—contains no advertising. Send for *your* free copy.

ALLIS-CHALMERS, MILWAUKEE 1, WIS.



A-1652

ALLIS-CHALMERS MOTORS

When you do need new motors, look into the strength, solidity and all-around protection of the new "Safety Circle"—protected top, sides, ends and bottom.

AC WE WORK FOR VICTORY WE PLAN FOR PEACE

READY! Simplified Catalog of G-E Renewal Parts

HELPS GET PARTS FASTER

- ✓ Quickly identifies needed parts—pictorially!
- ✓ Simplifies ordering by catalog number
- ✓ Speeds delivery from G-E warehouses or factories
- ✓ Gives dimensions, descriptions, prices on all parts required most frequently
- ✓ Includes parts for G-E motors, control, switchgear and other widely used electric equipment; also supplies, such as magnet wire, insulating materials
- ✓ Makes it easier to order *genuine* G-E parts, for better fit and long-lasting performance

NOW, a single book—indexed for easy reference—can take the place of separate handbooks and bulletins for identifying and ordering most G-E renewal parts needed to keep your equipment in operation. With this book, you'll find it easier to order genuine G-E parts *by catalog number*—saving time all along the line.

For your copy, just mail the coupon. Even though you don't need it now, it may save precious hours in an emergency. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

General Electric Co., Section AL 750-220
Schenectady, N. Y.

Yes, I want a copy of your new 96-page catalog "Renewal Parts and Supplies (GEA-638)" to help simplify ordering of genuine G-E parts.

Name.....

Company.....

Address.....

City.....State.....

226

ASH

Originators and Builders

of Modern Ash and

Dust Handling Equipment

In the early 1920's boilers of much larger size were being developed, varying from 50,000# steam per hour to 100,000# steam per hour, and of course with these larger units there was much more ash to handle and the quality of the ash was different because they were pushing these larger boilers at higher ratings. It was also at this time that some boiler plants started to use pulverized fuel, and here we had a problem because of slagging difficulties in the lower furnace and on the walls. This led to the development of the Hydrojet System. In order to see what was accomplished by the development of this system, we would ask you to compare the illustration on page two (2) of Catalog #1238 (Write for it) with the illustration on page sixteen (16) of Catalog #639 (Write for it). In the first case we have the hoppers and gates serving an under-feed stoker fired boiler, and in the second case we have a Hydrojet System serving an underfeed stoker fired boiler. Since the Hydrojet System stores ashes from the clinker rolls to the floor, it will be noted that the headroom normally used for car or man clearance (usually 6') is saved when a Hydrojet System is used and the ash hopper storage is the same. This amount of excavation and building steel usually pays for a very fine ash handling system. In the case of the hoppers and gates dumping into cars, it is necessary to have a man fill these cars and push them to a dump or skip hoist pit, and this operation is carried on continuously until such time as the ashes are finally all removed. About an average of five (5) tons per hour can be handled in this fashion and either one or two men are used, depending upon the quality of the ash and other local conditions. In the case of the Hydrojet System, we handle ashes at the rate of ½ ton to 1½ tons per minute, (average 60 tons per hour) depending upon the final disposition, with no labor other than turning on and off valves.

Naturally, the development of the Hydrojet System was revolutionary and today ash hoppers and gates with cars are very rarely used.

The clinker grinder stoker has not changed much since its development except for refinements in operation, but pulverized coal furnaces have changed considerably. The first furnaces were relatively small and boilers were not pushed to any great degree so that if coal of good quality was used not much slag was encountered, but as the units grew larger and ratings were increased, the slag problem grew worse and the scheme of quenching the molten ash in order to cool and disintegrate this slag in so-called dry bottom furnaces was first developed in the Calumet Plant of the Commonwealth Edison Company in Chicago. Even though a good coal is used, that is, a coal which slags at a temperature above 2000 degrees, we practically always encounter slagging difficulties in so-called dry bottom furnaces (as distinguished from slag tap) and provide for quenching which throws a continuous fine spray of water over the entire ash hopper. This keeps the hopper cool and at the same time disintegrates any slag which drops from the furnace.

(Continued in January)

MAKE YOURSELF TO

Written Specially for the
Allen-Sherman-Hoff Company
BY

Lowell T

A few weeks ago I had the privilege of hearing the advice given to a graduating class of naval aviation cadets at Pensacola. Two sentences stick in my mind:

"If you can make yourself tougher—do so! I mean physically, mentally, morally and spiritually."

The speaker was no pedantic schoolmaster officer. In the first year of the war he had been Captain of the Aircraft Carrier ENTERPRISE and consequently was a veteran of the toughest battles fought in the Pacific. He is today Rear Admiral George O. Murray, Chief of Naval Air Training.

It is the policy of our navy to have our cadets taught by officers who have been through it. The youngsters now learn the hard business of war from men who themselves have learned it the hard way. Among the training staff at Jacksonville, Florida, for instance, I met one of the top ranking air heroes of the campaign in the Pacific. How tough he is you may judge from the decorations he has earned: the Air Medal, the Navy Cross, the Distinguished Flying Cross. His name: Lieutenant Commander Edwin B. Parker, U.S.N.

It is fortunate for us all that our fighting men are tough, deliberately tough. In the Germans and the Japs they have tough enemies to meet. But it is a peculiarity of our men—and the British also—that they can be tough without being blackguards. Of this there is no apter illustration than Parker. Physically he is a blue-eyed, six-footer, thirty-two years old, with a blond moustache and blond hair, thinning on top. He is lean and ascetic looking with a long, thin face, long, thin fingers. In civilian clothes you might take him for a writer, lawyer or musician. His only visible indicia of toughness are in his hard, square jaw and a steady, steely look in his eyes. He speaks softly, even when uttering his impatience about incompetence, inefficiency or the red tape of the bureaus. When he is not fighting or teaching the art of war, his pastimes are reading law or playing with his five-year-old son and four-year-old little daughter. Like so many of the Navy men I have met, Lt. Commander Parker, D.F.C., N.C., A.M., talks but little about what he has been through. He is reserved but friendly, not the least "stand-offish." The enlisted men swear by him.

So much for the man. Let us see how the sailor arrived where he is.

Parker is a San Franciscan, went to Lowell High School and Drew Prep, graduated from Annapolis with the class of 1935. After a tour of duty at sea he elected to become a flyer and won his wings at Pensacola in 1939. Since then he has served on no fewer than four of Uncle Sam's carriers: YORKTOWN, SARATOGA, ENTERPRISE and HORNET. When the Japs sank the HORNET, Parker was Squadron Commander of Torpedo Squadron No. 6. During one year on the Pacific, Parker went through as many actions as most officers of previous wars saw in a lifetime.

The leader of a torpedo bomber squadron has to be superlatively good. When we visualize them in combat we have to remember this: in order to aim effectively they have to level out and fly level for several seconds before discharging their torpedoes. It needs little imagination to realize that this makes them juicy targets for the anti-

ALLEN - SHERMAN

TOUGH!

Thomas

aircraft gunners. It is well to bear that in mind as we consider the achievements of Lieutenant Commander Parker.

It was in the Faisi-Shortlands area of the Pacific that he won the D.F.C. Our scouts had spotted a heavy concentration of Japanese supply and troopships, all set to be used against our Marines at Guadalcanal. Parker and his colleagues took off from the HORNET early one morning, with him leading the second wave of planes. As they went in the first wave was badly broken up, so that only some half a dozen single planes of that group got through to the target. But all of Parker's division made it, plus their escort. The weather was thick and they had to go "downstairs" to see the water. Promptly a Jap heavy cruiser, one light cruiser and four destroyers began throwing flak at Parker and his group. But they picked themselves a large transport as a more important target because the idea was to prevent the Japs from landing reinforcements and supplies on Guadalcanal. In their first dive Parker and his division got three hits on that transport—and they were enough, she sank. Then they saw a seaplane tender and scored four hits on her. The end of that day's story was that the Jap concentration was broken up and the biggest attempt to reinforce their units on Guadalcanal was decisively defeated.

For his part in the Battle of the Santa Cruz Islands, Lieutenant Commander Parker won the Air Medal. Again an enemy fleet was trying to get to Guadalcanal. An action developed which involved the HORNET and another U.S. carrier. At the outset it appeared to be carrier against carrier. But the Americans soon found out the Japs had an imposing force.

"We knew the day before that there were two or more carriers against us," said Parker. "Our PBY's were over the Jap carriers all night, but we failed to send up a night attack group. Early next morning we lost contact with the Jap force. A scouting squadron finally made contact again and put two bombs on one carrier. Two groups of planes were launched from the HORNET and two from another carrier.

"I was in the first wave of the HORNET'S group with six torpedo planes. Another officer was in charge of the first wave of dive bombers, and was under attack by fighters for about an hour. I was able to watch a lot of action without their seeing me, and it was a lucky break for I was without fighter escort.

"The only way to get through was to keep out of sight. As it turned out I didn't find any carriers, so I decided to attack a heavy cruiser. This was just one of a group of 16 heavy cruisers which I had sighted, and each of them had a destroyer along. Our attack was successful. Of the six planes going in, five torpedoes were dropped. One failed to drop. Two ran erratic. The other three ran true. We got three hits on a Nachi class cruiser. The attack stopped her dead, and there was an explosion which sent fire up through her stacks. We left her listing to port, dead, with a fire raging on her.

"My plane had been hit several times. The Japs always try to shoot down the leader. Damage was superficial except the wounding of my tunnel gunner, and he was not fatally hurt.

"When we reached the HORNET she was in poor shape, and we were ordered to join another carrier. Just as we got over to this carrier the Jap torpedo planes attacked her and we hauled out of range. We went back in just as the Jap dive bombers came in. We had a grandstand seat for this show, and our anti-aircraft was credited with 36 enemy planes."

Finally Commander Parker and his group joined the second U.S. carrier, and went out on another expedition. "We were running out of gas, and when we got back I was forced to land in the water," he said. "I got out my life raft, climbed into it, my plane sank and shortly thereafter I was picked up by a destroyer."

Lieutenant Commander Parker won the Navy Cross as the result of his bravery and skill at Tulagi and in the Coral Sea. "Tulagi was one of our bases," he recalls, "but one Sunday the Japs just walked in and took it. The following Monday we went in to look over the situation. We got into Tulagi and found many lovely targets at anchor. Apparently everybody was asleep. With good cooperation from the dive bombers we got the torpedo planes in without more than normal anti-aircraft resistance.

"After we dumped our first load we went back after more fish, loaded up again and came back. This time a minimum of targets could be seen. That first attack had been highly successful. Very few targets remained."

Then came the Coral Sea. On the very first day Commander Parker's group scored 100 per cent hits on an enemy carrier, and the average score was 60 per cent during the second day.

U.S. losses in torpedo planes were unbelievably small in the Coral Sea, Tulagi, Solomons and Santa Cruz actions. "In all of those actions we did not have a single plane shot down by enemy aircraft or enemy fire," says Commander Parker. "Although several men were superficially wounded we didn't lose a single plane. One torpedo bomber was lost, but it was not due to Jap action."

Of such fibre is the officer in charge of training our youngsters in torpedo bombing. Commander Parker reports: "The biggest advantage of having had combat action is that student officers will listen to you."

That is a pretty fair understatement.

LOWELL THOMAS

Lowell Thomas, who has been broadcasting the day-by-day adventures of mankind without interruption for the past thirteen years, has had a varied and adventurous career. He was born in Ohio in 1892, reared in a Colorado gold camp, and has lived all over the world. As a young man he was a gold miner and cow puncher. Then he turned to newspaper work as a reporter and editor. After attending and receiving degrees from four universities, he became a member of the faculty of Princeton University.

As a speaker—before his radio days—he probably appeared in person before more people than any other man in the history of the platform.

As a traveler, he has led expeditions into the far north, into the tropics, and across remote sections of Central Asia.

He is the most widely known of screen commentators, and for the past ten years has been the Voice of Twentieth Century-Fox Movietone, the newsreel that has the widest circulation.

For thirteen (13) years now he has been the leading radio news commentator. By short wave and by broad wave his broadcasts circle the world.

N HOFF CO. 227 S. 15th STREET • PHILADELPHIA 2

OFFICES IN PRINCIPAL CITIES

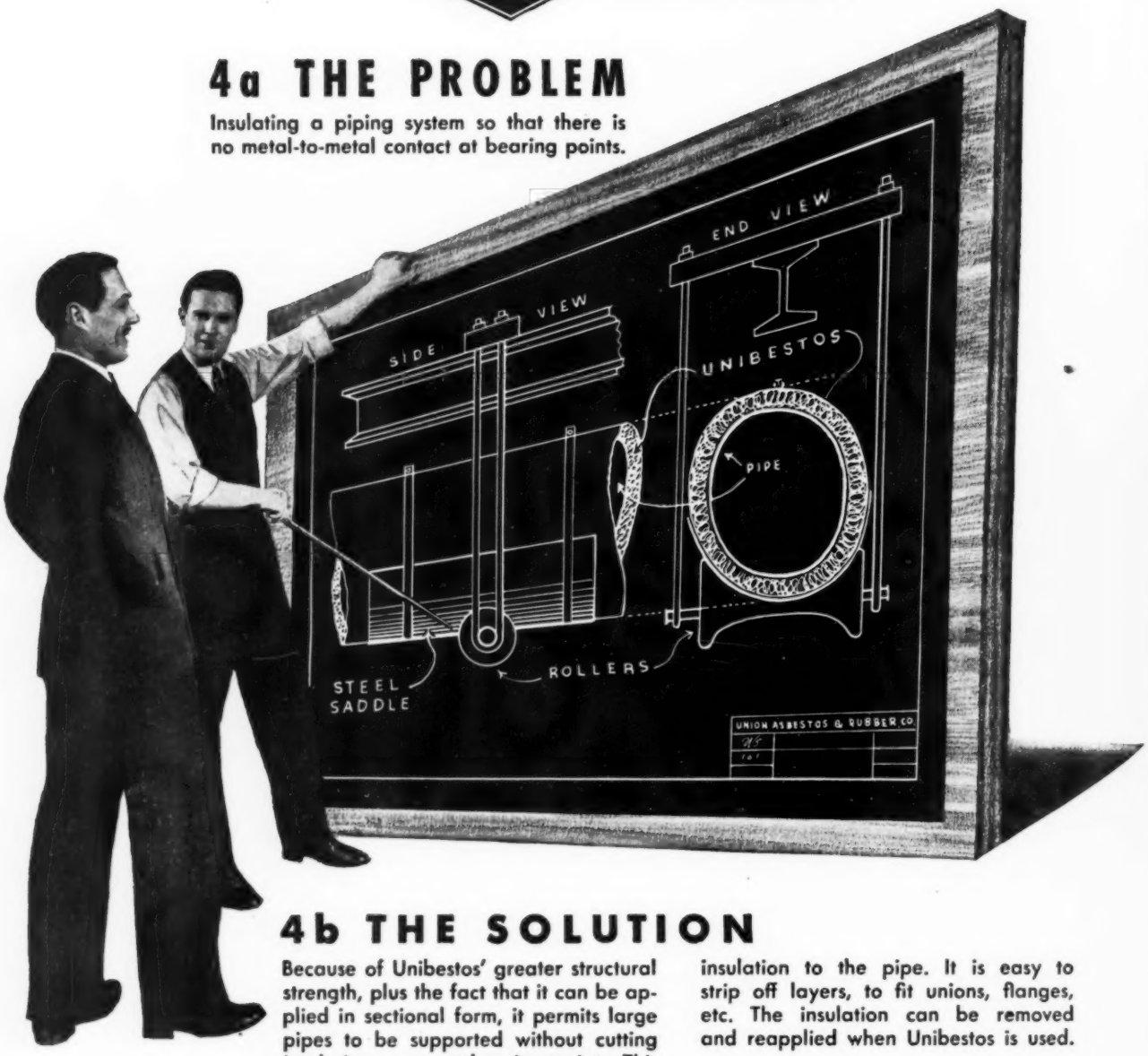
This is the 4TH in a series of messages

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING

UNARCO unibestos

4a THE PROBLEM

Insulating a piping system so that there is no metal-to-metal contact at bearing points.



4b THE SOLUTION

Because of Unibestos' greater structural strength, plus the fact that it can be applied in sectional form, it permits large pipes to be supported without cutting insulation away at bearing points. This is done by laying a steel saddle under the insulation at points where the pipe is supported by rollers, tie rods or other means. This makes it unnecessary to cut away the insulation or to use metal supports that penetrate through the insulation to the pipe. It is easy to strip off layers, to fit unions, flanges, etc. The insulation can be removed and reapplied when Unibestos is used.

unibestos is available in Standard material, for temperatures up to 750°; Super, with a temperature limit of 1200°; Combination, with a temperature limit of 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes. Unibestos is available in half sections up to 30" pipe diameter and from 32" to 60" in quadrants from ¾" to 5" in thickness. Standard and Super are available in single layer construction with provision for expansion in piping, where required.

TWO ARMY-NAVY "E" AWARDS FOR EXCELLENCE IN WAR PRODUCTION
ONE TO THE CICERO, ILLINOIS PLANT, ONE TO THE PATERSON, N. J. PLANT

UNION ASBESTOS & RUBBER CO.

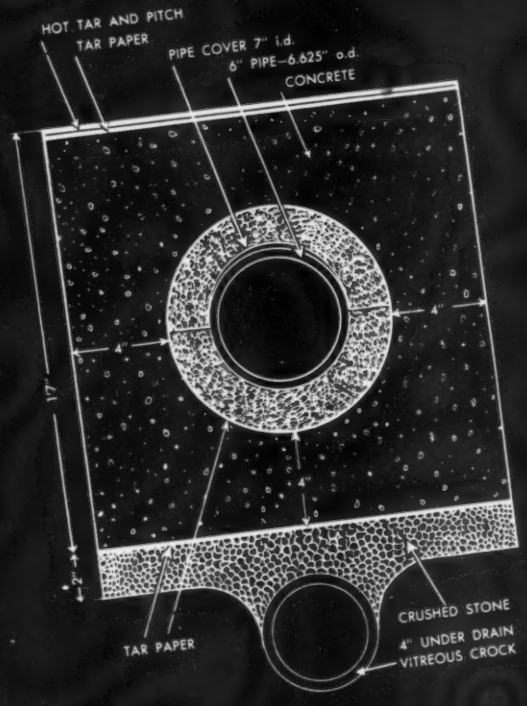
GENERAL OFFICES: 1821 SOUTH 54TH AVENUE, CICERO, ILLINOIS • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

This is the **5TH** *in a series of messages*

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNARCO unibestos

5a THE PROBLEM: Permanent insulation of underground steam line.

5b THE SOLUTION:

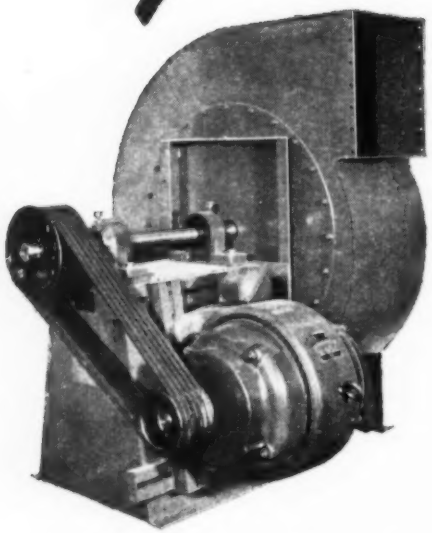


Dig underground trench to proper grade and lay sewer tile over which two inches of crushed stone is placed. Cover crushed stone with tar paper. Install pipe on wooden blocks arranged to support pipe for welding. After welding apply Unibestos sectional pipe covering to allow free movement of the pipe within the insulation, insulation should have an I. D. approximately ⅜" greater than the O. D. of the pipe. Pipes should next be brought to proper grade adjustment after waterproofing the insulation. The trench should be filled with concrete. Tar paper and tar can then be applied on top of the concrete to make the structure waterproof. The great structural strength of Unibestos permits this unique installation. Unibestos is sufficiently strong to withstand the movement and weight of the pipe.

UNION ASBESTOS & RUBBER CO.

GENERAL OFFICES: 1821 SOUTH 54TH AVENUE, CICERO, ILLINOIS • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

Progress and Power in the



American Blower general purpose industrial Type E exhauster.

No basic industry in America has been called upon to bea a heavier war burden than the great Aluminum Industry From the early days of cash-and-carry, aluminum producer have worked shoulder to shoulder with America's electri power producers to help build the weapons and machine which are today's assurance of Victory.

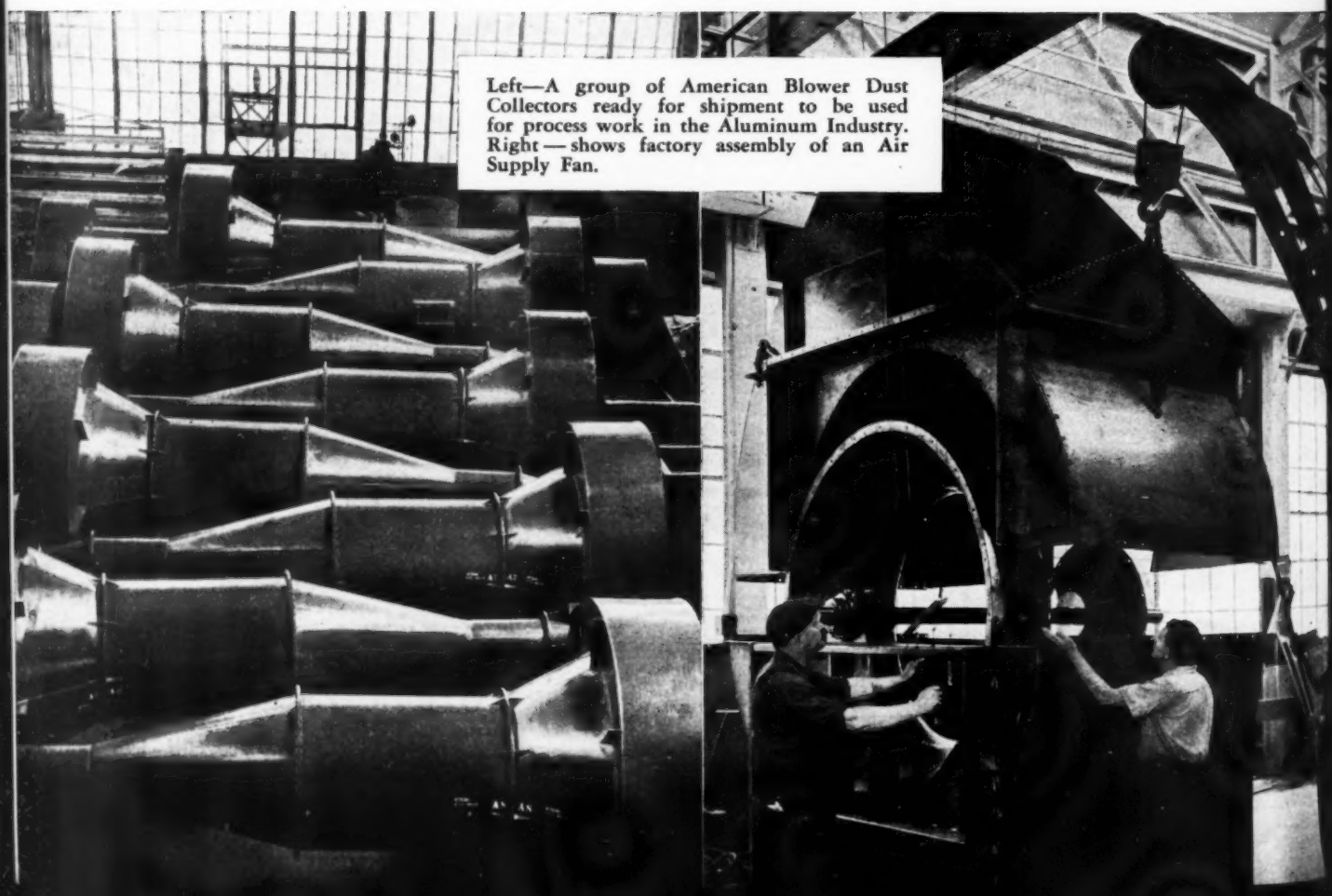
In the power plants, too, which supply America's count less war industries, American Blower Mechanical Draft Fan and Fluid Drives are helping set new peak records of electri energy output.

After Victory, American Blower will be in a position t supply the Public Utilities and all other industries with a ever increasing amount of mechanical draft equipment, heat ing, ventilating, dust collecting equipment and Fluid Drive

ARMY E NAVY
For Production
"Well Done"

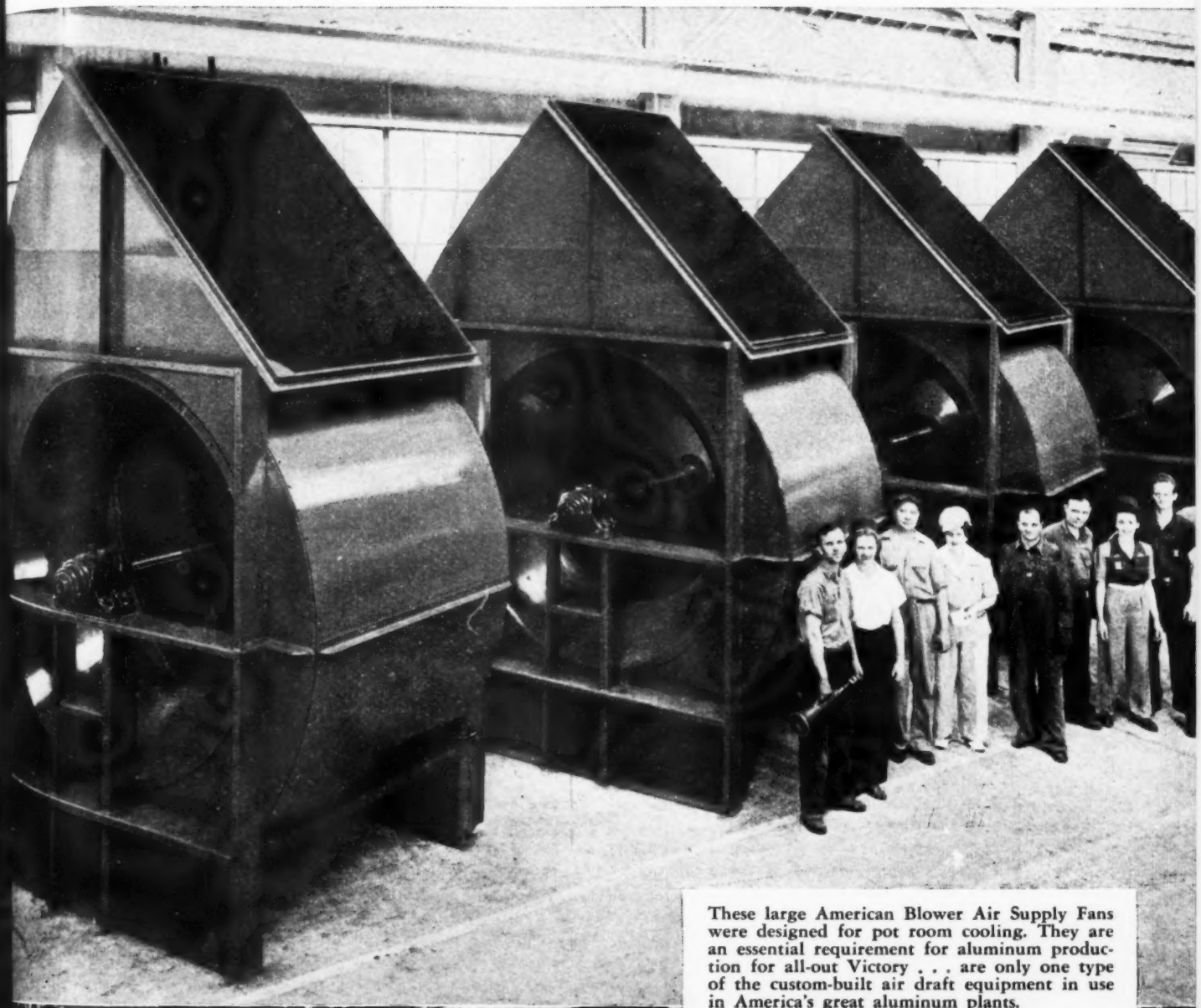
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGA
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARI
Division of AMERICAN-Radiator and Standard Sanitary Corporation



Left—A group of American Blower Dust Collectors ready for shipment to be used for process work in the Aluminum Industry. Right — shows factory assembly of an Air Supply Fan.

ALUMINUM INDUSTRY



These large American Blower Air Supply Fans were designed for pot room cooling. They are an essential requirement for aluminum production for all-out Victory . . . are only one type of the custom-built air draft equipment in use in America's great aluminum plants.

A battery of special Purifiers, under construction at one of American Blower's three great plants, for air purification and cooling electrical equipment in the Aluminum Industry.

Seesaw "Coal-oil-Coal" Conversions End Up With TAYLOR STOKERS

ALMOST 20 years ago in 1924, a certain New England plant installed two Taylor Stoker fired boilers. The performance of the stokers was perfectly satisfactory... but, after several years, a favorable turn in fuel oil prices made permanent conversion to oil firing seem logically and economically advisable. So the stokers were removed.

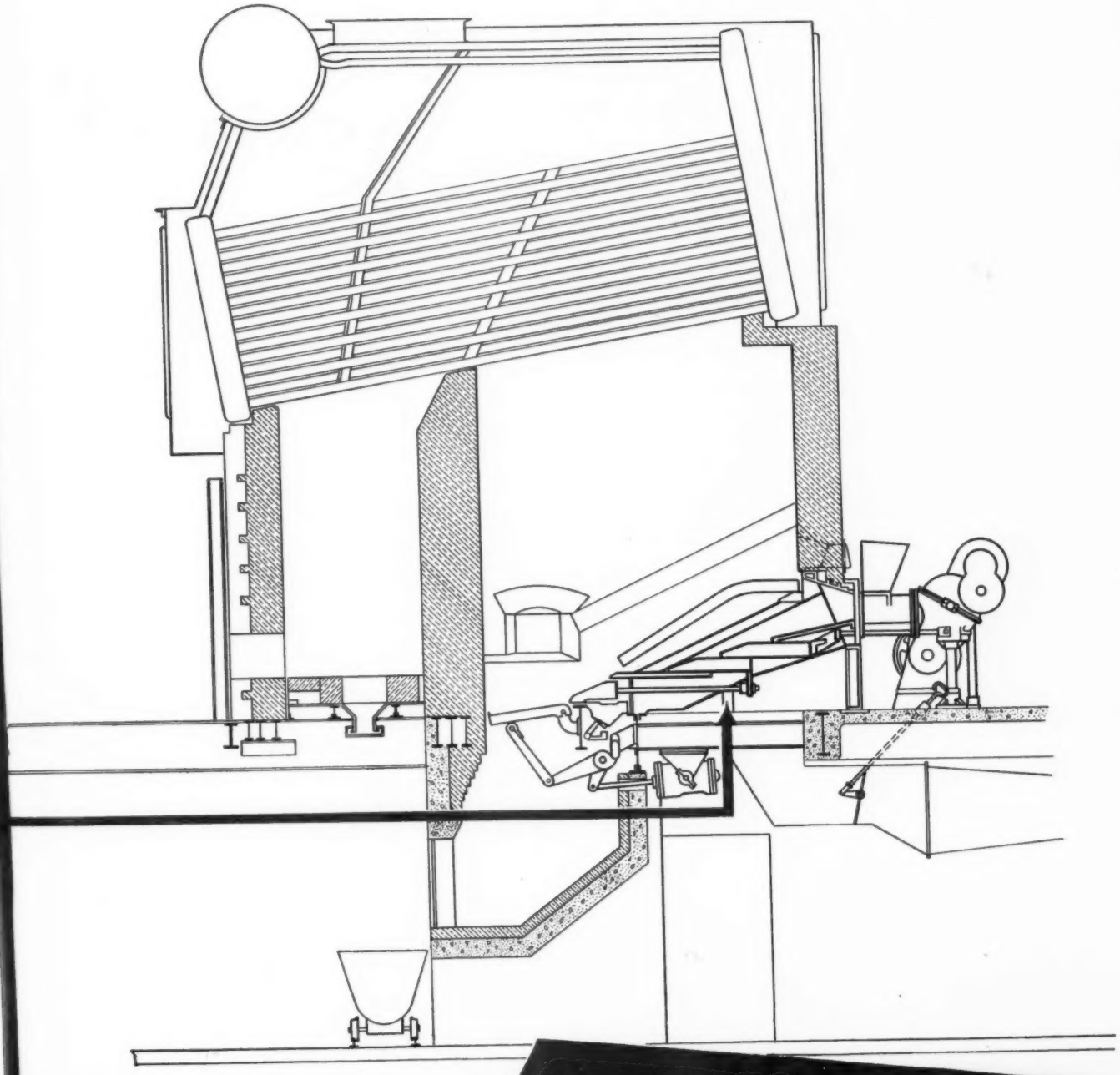
Then, a few years ago, coal again became economically available. One boiler was reconverted to coal firing and, on the strength of past experience, the reconversion included a Taylor Stoker. Hardly had this step been completed when war and fuel oil restrictions necessitated changing over the second boiler. The second Taylor Stoker was purchased early this year and is now in service. This plant KNOWS what Taylor Stokers can do!

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward ... quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved **dollar** efficiency (**total** cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



A-E-CO TAYLOR STOKERS
LO-HED HOISTS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

A-E-CO
TAYLOR STOKER

COMPANY

Æ CO 75th ANNIVERSARY

...then perhaps he said to himself

A TEN-MONTH DELIVERY

MR. ROOSEVELT'S LETTER

President Roosevelt's letter to Mr. Churchill read as follows:

Dear Mr. Prime Minister:

When you were with us during the latter part of December, 1941, and the first few days of 1942, after we had become active participants in the war, plans for a division of responsibility between your country and mine became generally fixed ... standing ...

Here there had been developed a welding technique which enables us to construct standard merchant ships with a speed unequaled in the history of merchant shipping.

... well as in other matters, we agreed that mutual advantages were to be gained by concentrating, in so far as it was practical, our energies in doing those things which each of us was best qualified to do.

Here in this country in abundance were the natural resources ... critical materials.

Here we had waiting cargoes ... be moved in ships to your ... and to other theatres. If ... country was to have carried out its contemplated ship construction program it would have been necessary to move ... tonnages of raw materials ... we have here across the Atlantic to your mills and then, in form of ships, to send them back ... ports for the cargo ... waiting to be carried.

Materials and Time

Obviously, this would entailed a waste of ... time.

It was only natural ... to decide that this ... be the predominating ... area for ...

BIG PIECE OF NEWS the Prime Minister read to the House of Commons—the 10-months' delivery of a couple hundred ships.

Again the old formula: BIG name in the NEWS . . . made big by Big Production . . production made big by RECOURSE TO ARC WELDING (remembering Webster's short definition of RECOURSE as "a going to for aid or protection").

So the President has written the formula into the history of the world: "Here there had been developed a welding technique . . . with speed unequaled."

THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO

"A Welding Technique" *he said*

★ ★ ★ ★ *"with speed unequalled in the history of merchant shipping"*

...and this, Mr. Prime Minister, is what he meant:

SHOP FABRICATION. Ships welded on a production line by assembly line methods—faster welding by positioning the welding—pre-fabrication of large sections—upside-down assembly—dozens of short-cuts make up this technique, recourse to which has revolutionized shipbuilding.

MASS PRODUCTION. If ships can be put on a mass production basis, think of the speed and economy in producing products less bulky. If speed alone were the only benefit of welding, *recourse* to it might be debatable. But consider these additional benefits:

LESS STEEL
On these 200 ships, *recourse* to arc welding saves 375,600 tons. Steel is critical. Steel costs money.

LESS HULL FRICTION
A welded Liberty ship leaving New York would reach Sicily 40 hours quicker than its rough-skinned sister of equal horsepower.

INCREASED CARGO
18% more cargo carrying capacity is provided by weight-cutting through *recourse* to arc welding.

America's greatest natural **recourse**

ARC WELDING

to 20 Ships a Month

...der that the general un-
...ding we reached, during
...rly days of our engagement
...ther in this war, may be
...e perfectly carried out, and
...der as a practical matter to
...id the prodigal use of man-
...wer and shipping that would
...sult from pursuing any other
...urse, I am directing the War
...hipping Administration, under
...ppropriate bareboat arrange-
...ents, to number to your flag
...er temporary wartime duty dur-
...ing each of the suggested next
...ten months a minimum of fifteen
...ships.

I have furthermore suggested to them that this be increased to twenty.

We have been allocating to British services on a voyage-to-voyage basis large numbers of American-controlled ships. What I am now suggesting to you, and what I am directing the War Shipping Administration to carry out, will be in the nature of a substitution to the extent of tonnage transferred for the American tonnage that has usually been employed in your war program.

Details of the arrangements we can properly leave to national shipping authorities for settlement through the Combined Shipping Adjustment Board, whose function it is to concert employment of all merchant vessels, and will in accordance with its usual practice do so in connection with these particular ships.

Always sincerely,
FRANKLIN D. ROOSEVELT.

Simplicity of Design Means Easier Maintenance

Here's how Interchangeability Speeds Maintenance . . . . .

All parts of the valves illustrated above, with the exception of bodies and bonnet rings, fit each other perfectly.

If, for example, you need a stem, disc, or seat ring for the "Renewo" and do not have it available you can use the corresponding part of the "Ferrenewo"—*it is exactly the same.* This means fewer parts to be carried, speedier repairs and greater ease in making them.

The same flexible interchangeability likewise applies between the various 300 lb. S.P. "Renewo" valves.

"RENEWO"—"FERRENEWO" VALVES

CHANGEABILITY Speeds Maintenance..

Never has proper valve maintenance been so essential as now. With the scarcity of new valves, it is all-important to take the best of care of those you have in service. The necessity for uninterrupted operation demands no less.

With regular checking and inspection of this vital equipment and prompt servicing when necessary, valve life can be lengthened materially. It may save more costly repairs and replacements later, and the possible shut-down of equipment.

The simplicity of design of Lunkenheimer "Ferrenewo"—"Renewo" Valves, with interchangeable parts, makes them easy to keep in good operating condition—easy to maintain. It means speedier repairs with minimum expenditure for maintenance.

The complete facilities of Lunkenheimer distributors are at your service. They'll help you get what you need and there's one near you to serve you.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

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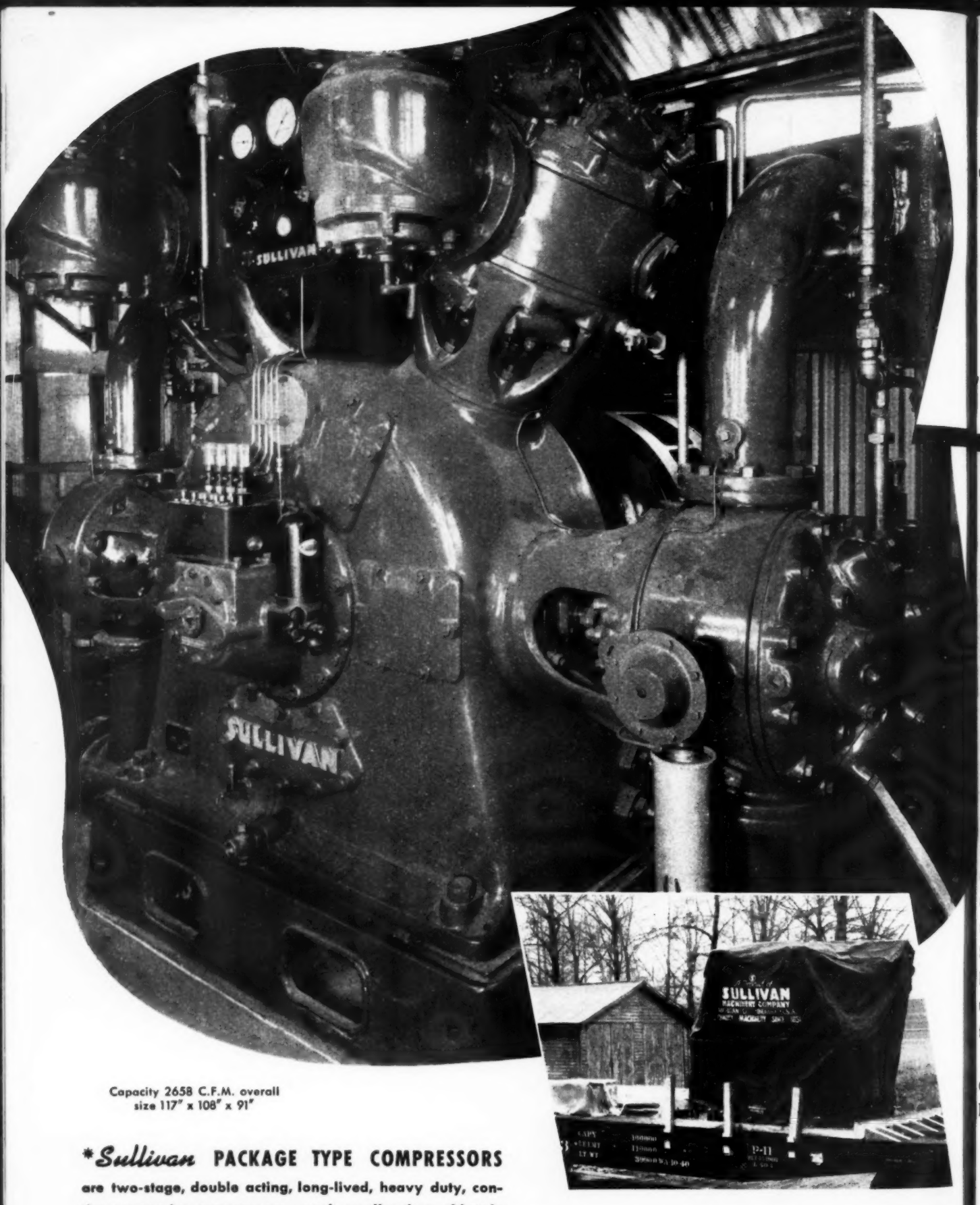
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y

Ask for Lunkenheimer Catalog No. 78 and the Guide for selecting Valves, Boiler Mountings and Lubricating Devices.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

No. 102-92-42



Capacity 2658 C.F.M. overall
size 117" x 108" x 91"

*Sullivan PACKAGE TYPE COMPRESSORS

are two-stage, double acting, long-lived, heavy duty, continuous service compressors—much smaller than old style compressors of the same capacity—and yet have operating economies equal to or exceeding those of the older bulky units of the same capacity. Package Type Compressors need only to be hooked up to power, water and air lines and they are ready for 24-hour per day constant and efficient service. They are particularly suitable for synchronous motor drive and extremely well adapted for drive from steam turbines or diesel engines.

FEATURES OF ALL *Sullivan* P. T. COMPRESSORS

Most modern metallurgical developments, engineering design and precision manufacture used throughout. Lifetime service anti-friction main bearings, crossheads and crosshead liners. Non-adjustment crosshead bearings run in mirror-finish honed crosshead guides which last indefinitely. Exactly balanced low pressure and high pressure pistons. Removable cylinder liners honed to a satin finish.

17,000 HOURS OF CONTINUOUS COMPRESSOR OPERATION

..at a parts cost of less than $10.00 a year

IT MAY SOUND AMAZING TO YOU BUT IT'S WHAT PT* OWNERS EXPECT

● If you are not familiar with the low-cost, long-lived dependable performance of Sullivan Heavy-Duty Package Type* Compressors, you may be interested in the following typical history. In November 1940, a Sullivan Package Type* Compressor was installed in the plant of a busy Eastern arms manufacturer. It started running day and night and hasn't stopped running to this day except for necessary oil changes. In October 1942, a Sullivan Service Engineer made a routine check-up and learned that for the preceding 17,000 hours of continuous operation, less than $20.00 had been spent for replacement parts . . . under $10.00 per year. This outstanding performance record is but one of an increasing number being established by the Package Type Compressor in some of the toughest compressor jobs in this country. So successful has it been that the list of repeat buyers is growing steadily . . . and users say that never before have compressors of such quiet, dependable and trouble-free excellence been built. If you have a vital need for a heavy duty compressor or are planning for the future and want to know more about the performance of these compressors in *your industry*, write your nearest Sullivan branch office. SULLIVAN MACHINERY COMPANY, Michigan City, Indiana. *In Canada:* Canadian Sullivan Machinery Company, Dundas, Ontario.

BOSTON . . . . 104 Brookline Ave.
CHICAGO . 307 No. Michigan Ave.
NEW YORK . . . . . 30 Church St.
PITTSBURGH . . . 47 Terminal Way
ST. LOUIS . . . . . 2639 Locust St.
SAN FRANCISCO . . . 145 10th St.
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SULLIVAN

AIR COMPRESSORS

HEAVY DUTY, SINGLE OR TWO STAGE STATIONARY AIR COMPRESSORS IN ANGLE, V-VERTICAL, VERTICAL OR HORIZONTAL TYPES IN SIZES FROM ¼ TO 3000 H. P. ALSO A COMPLETE LINE OF PORTABLE COMPRESSORS

Look out for CONCENTRATION-CELL CORROSION

...the corrosion that hides!

Often better known as "deposit attack" or "crevice corrosion," this action usually attacks hidden and secluded areas of metal. It destroys metal more rapidly than ordinary corrosion.

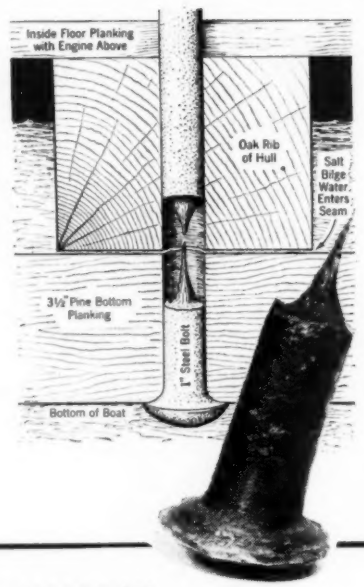
That concentration-cell corrosion "hides away" and is also fairly common may be judged by noting some of the conditions that favor it and where such attacks are likely to occur . . . cracks and crevices in welded seams; unsealed crevices of all types of lap joints; fissures in metal caused by forming operations; *under* and *around* various accumulations on metal surfaces . . . marine growths . . . silt, scum, and salt encrustations and deposits . . . scale in evaporator and condenser tubes; brine, acid or other chemical-solution soaked timbers around tie-rods, staybolts and similar metal members.

Other factors, such as wet packings in idle machinery, stagnant areas in tanks and pipes and many more conditions, far too numerous to list, also favor the action. Preventive measures usually become obvious when each case is examined from the standpoint of the principles of concentration-cell effect.

Our illustrated folder, "How to Recognize and Control Concentration-Cell Corrosion," tells how, why and where this corrosion action attacks so that practical control measures can be devised for practically any situation.

INCO's Technical Service, on request, is prepared to assist engineers further in solving or avoiding concentration-cell corrosion problems. As a first step in securing INCO's help in a specific case, write for a copy of the Corrosion Data Work Sheet.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.


Inside Floor Planking with Engine Above
Oak Rib of Hull
Salt Bilge Water Enters Seam
3½" Pine Bottom Planking
1" Steel Bolt
Bottom of Boat

Actual Example of Concentration-Cell Corrosion

The 1" steel bolt holding down the engine bed of a New York Harbor motor lighter looked like this sample after being in service only two years. See Note 9 below.

PRACTICES for PREVENTING CONCENTRATION-CELL CORROSION

1. In new equipment specify butt joints and emphasize the necessity for complete penetration of the weld metal to guard against even minute crevices.

2. Lap joints should be avoided wherever possible or thoroughly sealed with weld metal or solder. In place of metal, a suitable caulking compound may be used if crevices and voids under the compound can be avoided during application or can be quickly corrected if they appear during service.

3. Existing lap or spot welded joints, that show evidence of crevice corrosion, should be cleaned as well as possible and all channels for liquid penetration —rivet heads, overlaps, and all crevice-like areas—sealed with weld metal, solder or caulked.

4. In design of vessels avoid sharp corners, stagnant areas or other sites favorable to the accumulation of precipitates and other solids.

5. Institute a routine of frequent, thorough cleaning of all metal areas subject to accumulations of deposits, scale or "skins." In marine work this precaution applies to marine growths, silt, scum and salt encrustations and deposits.

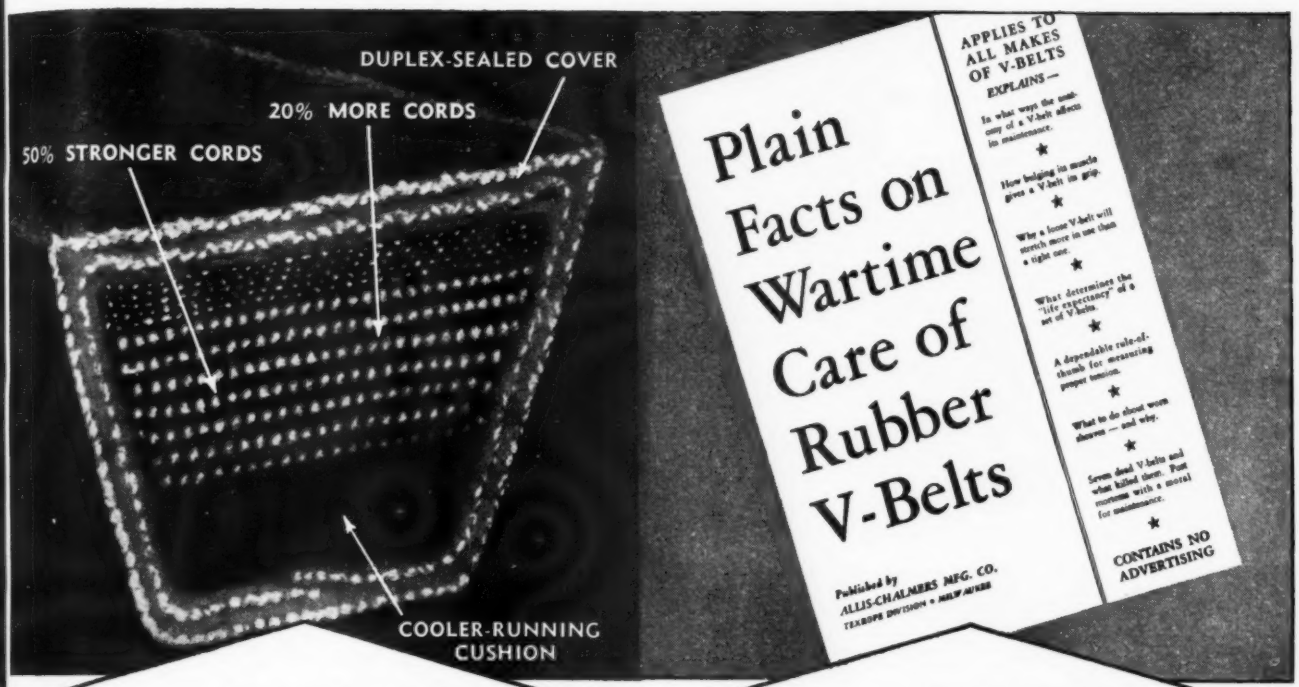
6. In the design and operation of tubular heat exchangers, endeavor to provide for uniform flow of liquid with a minimum of turbulence and air entrainment.

7. Provide suitable strainers in heat exchanger cooling medium lines to prevent local obstructions within the tubes which may start deposit attacks, or result in turbulence and impingement.

8. Remove all wet packing materials (unless of the corrosion-inhibiting type) from any equipment scheduled for a long shut-down period since concentration conditions under packings may become similar to those under deposits.

9. Because soaked timbers in contact with metal surfaces — tie-rods, pipes, stay-bolts, and similar members — promote concentration-cell effects, keep tie-rods tight and promptly repair all leaks in wooden tanks, even those that might otherwise be considered trifling. When soaking of timbers cannot be prevented, fastenings of highly corrosion-resisting metals offer the best protection. Fastenings of less resistant metals may be somewhat protected by coating with a suitable paint before installation.

Here's the Pair to Beat WARTIME V-BELT Wear!



1 THE BEST BELTS...

You're off to a "flying start" against maintenance worries when you get Texrope Super-7's design-against-wear construction. You get: 1) 20% *more* cords than before; 2) Cords made 50% *stronger* by special Flexon process; 3) Cooler-running rubber cushion that "floats" cords around sheaves; 4) Duplex-Sealed cover that guards against grime. When you *do* need new V-belts *invest in the best* — Texrope Super-7!

2 THE BEST CARE...

You'll get a head start on longer V-belt life — regardless of what brand you use—by following valuable tips in Allis-Chalmers' *free* handbook: "Plain Facts on Wartime Care of Rubber V-Belts". Here is the full story of V-belt care... packed with a wealth of practical data ... written so that new as well as experienced men will readily understand it. Contains no advertising. Tear off coupon and send for *free* copy today!

ALLIS-CHALMERS

TEXROPE* SUPER-7 V-BELTS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

*Trade mark registered U. S. Patent Office. Texrope Super-7 V-Belts are the result of the cooperative research and design genius of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by Allis-Chalmers. Available in all sizes.

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive free of charge a copy of your "Plain Facts on Wartime Care of V-Belts".

(Name)

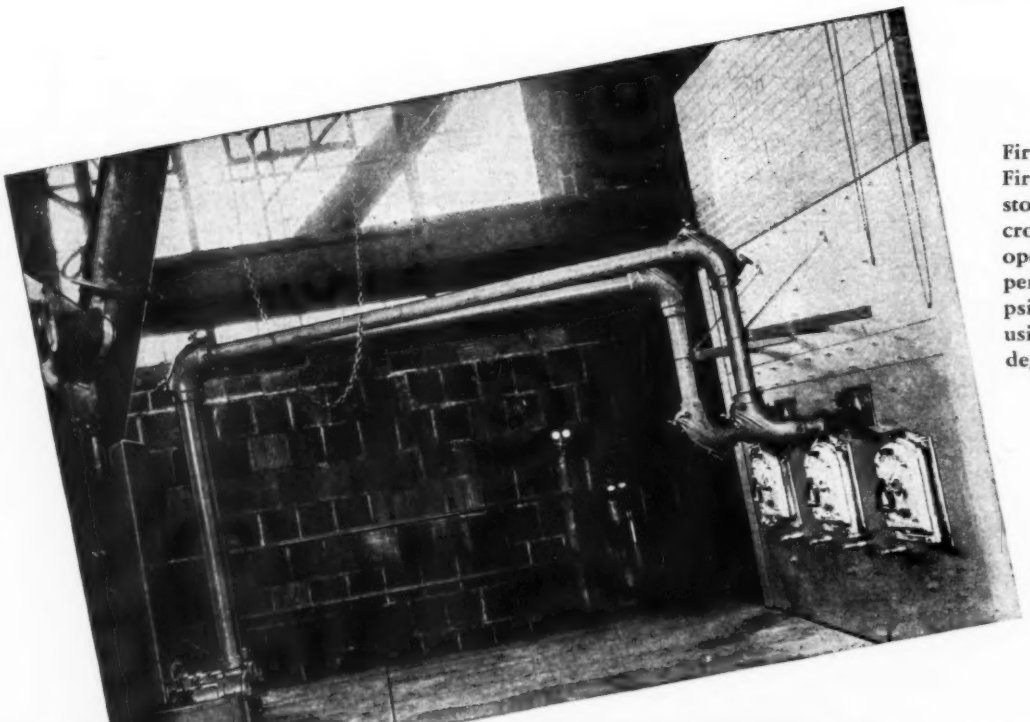
(Title)

(Company)

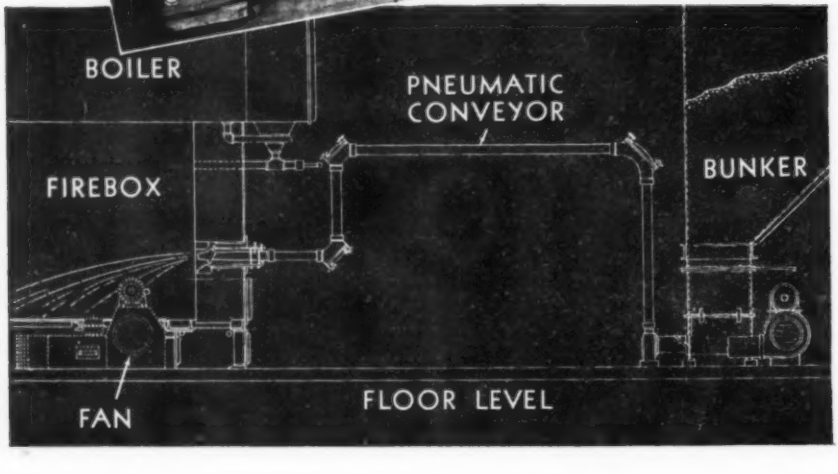
(Street Address)

(City and State) A 1656-5

IRON FIREMAN "Spreaders Sa



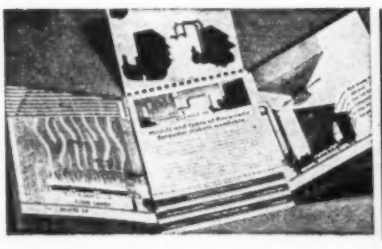
First installation of two Iron Fireman Pneumatic Spreader stokers, which fire 394 h.p. cross drum boilers. The boilers operate at approximately 200 per cent of rating, carrying 300 psi with 150 degree superheat, using preheated air at 350 degrees under the grates.



Power Plant, Halltown Paper Board Company Halltown, West Virginia.

35,000 Pounds of Steam Per Hour Produced During Peak Loads

Two Iron Fireman Pneumatic Spreader stokers serve two 394 h. p. straight tube boilers and operate at 1000 h. p. during peak loads. This is an output of 35,000 lbs. of steam per hour per boiler. The boiler pressure is 300 psi; superheating brings the steam temperature up to 650 degrees. An air preheater is installed which raises the temperature of the combustion air up to approximately 350 degrees. This installation at Halltown Paper has reduced auxiliary power cost and maintenance cost. Steam cost has been reduced from $.235 to $.18.



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layout and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3508 W. 106th Street, Cleveland, Ohio

Save Halltown Paper Board Co. Over $12,000 a Year

★ Burn Low Grade Coal with High Efficiency ★

• Because Iron Fireman Pneumatic Spreader stokers burn lower-grade coals, Halltown Paper Board Company installed them to replace multiple retort underfeed stokers of another type. Fuel savings alone have been remarkable—over $12,000 a year. These savings have liquidated the investment in less than three years.

This performance is typical of what Iron Fireman firing is doing in tens of thousands of boiler rooms. Iron Fireman automatic coal stokers, in addition to cutting fuel costs drastically, are increasing steam output 10 to 35 per cent—and are burning coal—a plentiful fuel.

How the P. S. Stoker Achieves its Remarkable Results

The Iron Fireman Pneumatic Spreader conveys steam size coal from the hopper or main coal bunker to a transfer housing, where the coal is picked up by a stream of air and conveyed to the furnace and grates. The fines burn in suspension, utilizing the conveying air for combustion. The larger pieces form a shallow fuel bed on the grate. By means of an adjustable nozzle, the coal is dropped by gravity and *distributed uniformly over the entire surface of the grates.*

The conveying air provides the overfire air which is, of course, a requisite of efficient combustion. This air is more intimately mixed with the coal than is possible by any other means. Entering at right angles to the flow of undergrate air through the fuel bed, the conveying air produces *maximum turbulence.* This conveying air, which has been heated by contact with furnace gases, preheats the coal before it enters the furnace. This results in rapid ignition and highly efficient combustion.

Applications are flexible; the stoker can be set at boiler room floor level, or on the floor above or below. It can be located at any angle in front of the boiler, and at distances of 30 feet or more from the boiler front.

The Iron Fireman Pneumatic Spreader stoker was designed to burn efficiently a wide range of such economical fuels as the lower-grade bituminous coals, and also sub-bituminous and lignite coals, and to provide *a reliability of operation, physical adaptability, ease of operation,* and *low maintenance* not afforded by other types of automatic coal burning systems.

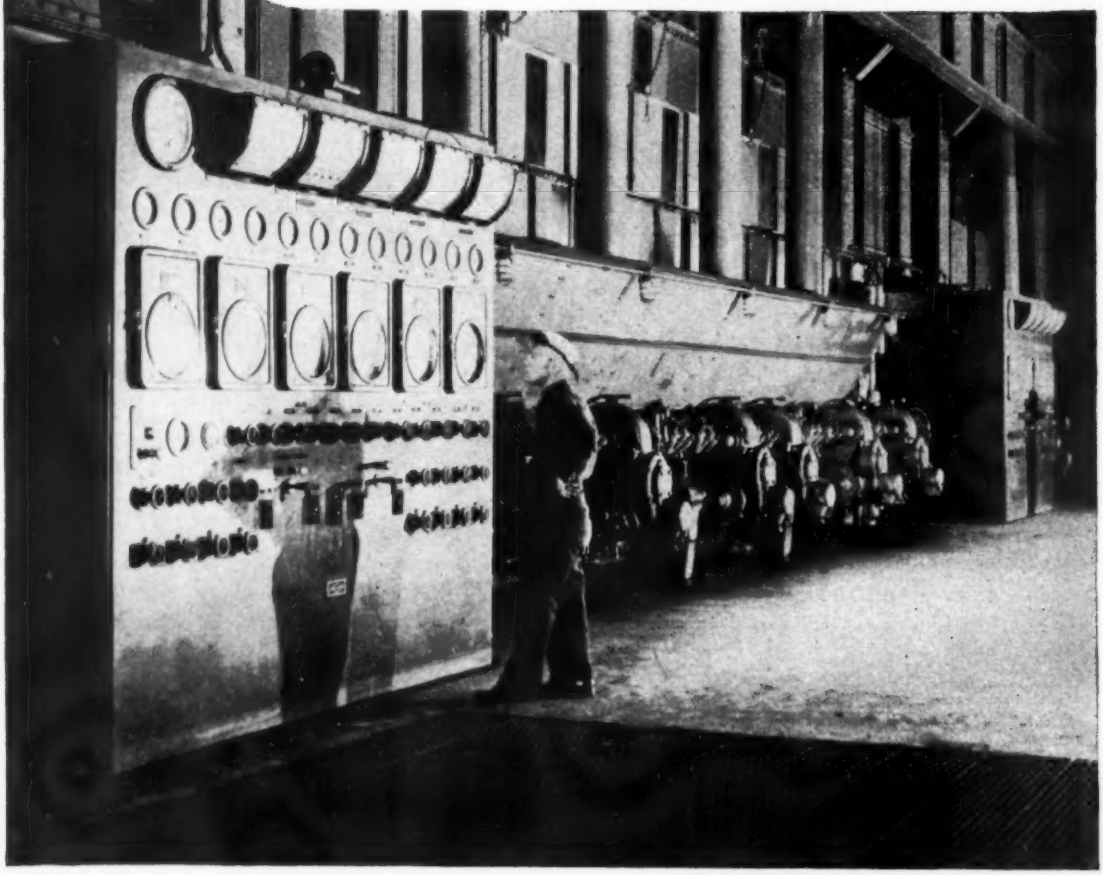
Iron Fireman Stokers are Available. Write for Information

Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Company, 3508 West 106th Street, Cleveland 11, Ohio.

IRON FIREMAN

Automatic Coal Stokers

Rifle-sight accuracy



IN POWER PLANTS Hagan Automatic Combustion Control increases steam output, reduces fuel consumption, keeps steam pressure constant, eliminates smoke trouble, maintains efficient operation even with new men.

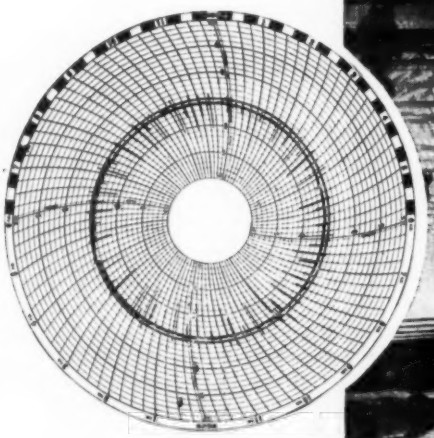
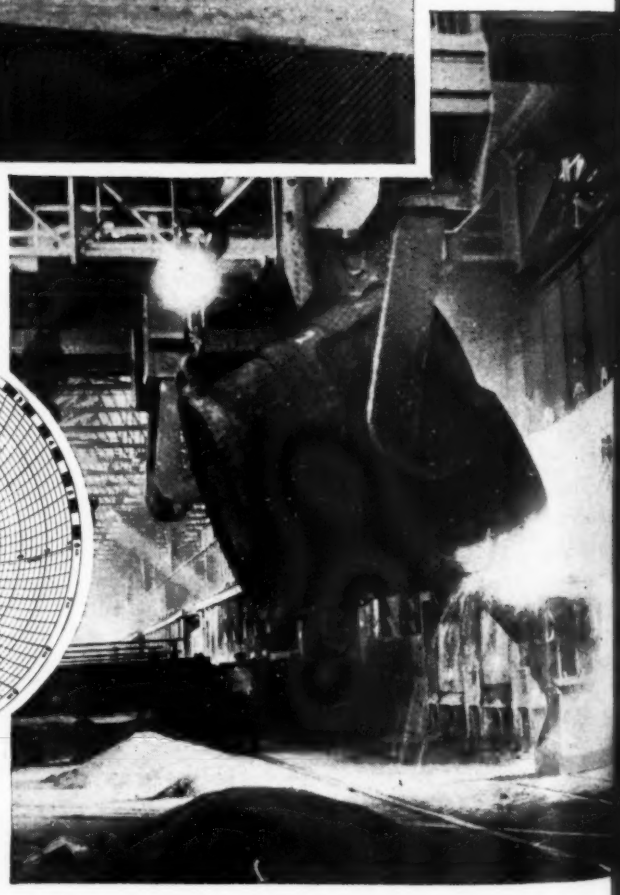


CHART SHOWS accuracy of pressure maintenance even under widely varying load conditions.



ON INDUSTRIAL FURNACES Hagan Control increases furnace output, cuts fuel consumption, results in faster, more uniform heating, steps up over all production, reduces spoilage.

# of Hagan Control . . .

helps conserve the nation's fuel supply

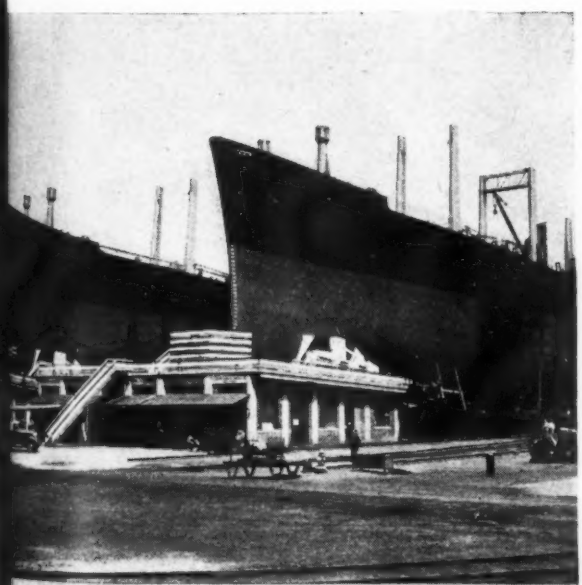
A TURBINE room engineer who was accustomed to seeing steam pressure *vary all over the lot* was having his first experience with Hagan Control. He discovered the pressure recorder was drawing almost a perfect circle. Not being used to such accuracy, he figured the gauge was stuck and proceeded to take it apart, only to find it in perfect working condition. About that time the Hagan Engineer happened along and put him wise to the fact that this was *usual* accuracy for Hagan Control.

Translate this accuracy into more efficient combustion and you will see how it has stretched the nation's fuel supplies. During the last war automatic combustion control was unknown until Hagan introduced it in 1917. We had fuel shortages so severe that expediters were riding coal trains to see that they reached the right destination.

Contrast this with the situation today. In spite of the fact that the United States is producing power almost double that used in the peak of 1929, we have had no permanent fuel shortages.

How much of this improvement is due to more efficient combustion is anybody's guess but of this we are certain—*almost every major boiler plant in the country is now equipped with automatic combustion control.* Furthermore, this fuel-saving apparatus is rapidly being installed on all types of industrial furnaces and steamships.

When Hagan Automatic Control goes in, fuel consumption drops. Sometimes it is only 1 or 2%, but more often it is 5 to 10%. This means that thousands of tons of fuel daily that formerly went up in smoke are now producing extra power to help win the war.



IN STEAMSHIPS Hagan Control increases cruising range or cargo-carrying capacity, eliminates the smoke hazard, maintains more constant superheat, steps up efficiency, obtains quicker response from boilers, carries on even if men are wounded.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.

MAXIMUM OUTPUT from boilers of differing capacities, automatically.

MAXIMUM STEAM for production, by reducing loss of steam in frequent soot-blowing.

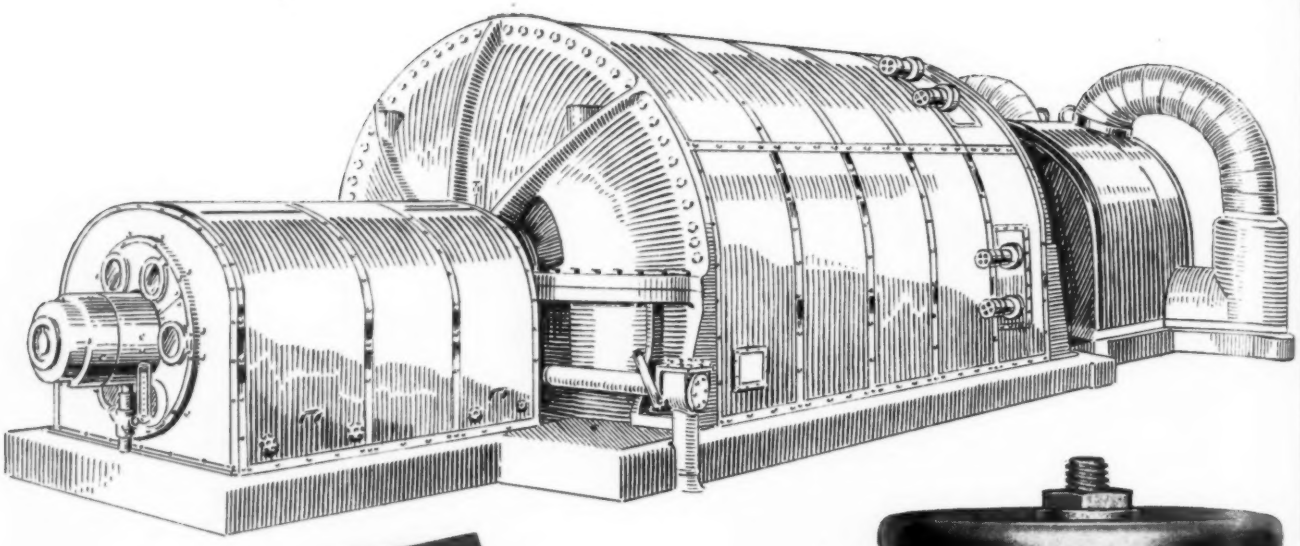
MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN CORPORATION
HAGAN BUILDING
PITTSBURGH (30), PA.

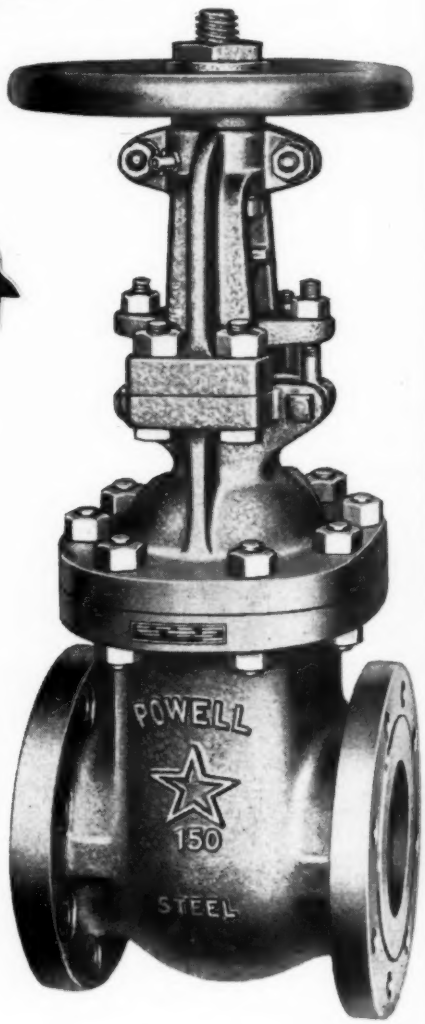
HAGAN HALL BUROMIN CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader



LINKS IN THE CHAIN OF VICTORY



Every time you hear of the industrial miracles that are being performed today, remember that wherever there is production there must be power and that, *next to the men*, the most important links in the chain of victory are the valves that control the liquids and gases that give power to industry.

POWELL devotes to the manufacture of valves . . . and valves only . . . the skills developed through nearly a century of *specialized* valve manufacture.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati, Ohio

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes 1″ to 24″ inclusive.

POWELL

The complete POWELL Line includes Globe, Angle, Gate, Check, Relief, Y, Non-Return and other types of valves in bronze, iron, steel, pure metals and special alloys to meet the demands of all branches of Industry for DEPENDABLE FLOW CONTROL EQUIPMENT.

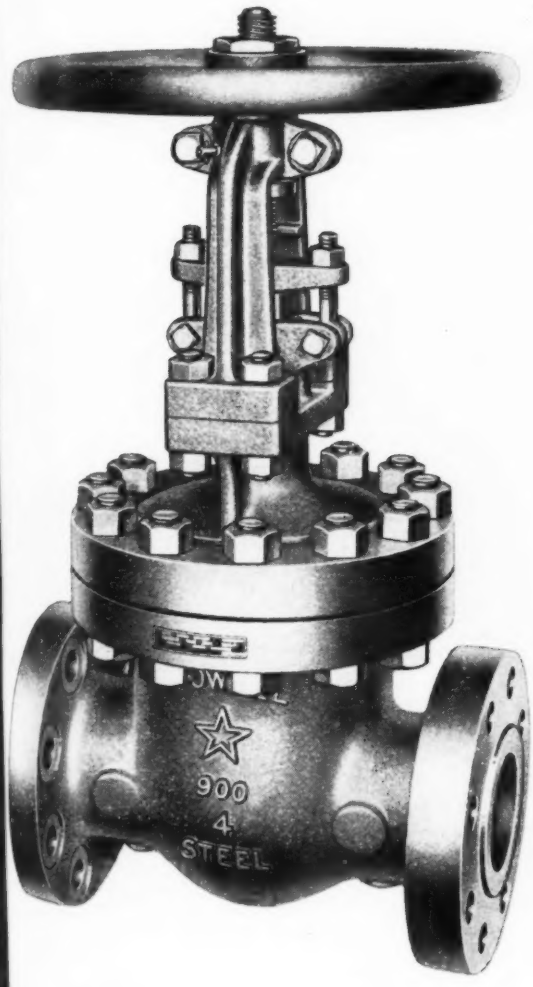


Fig. 9003—Class 900-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, full bolted flanged yoke and taper wedge solid disc. Sizes 3″ to 18″, inclusive.

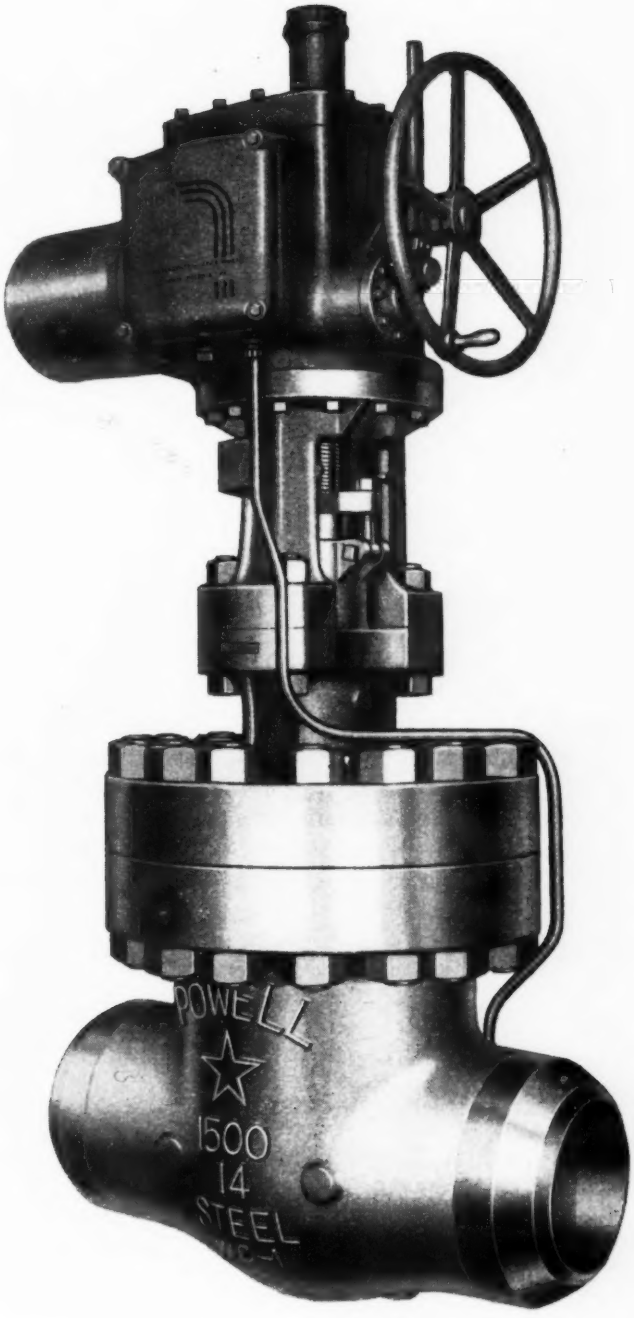
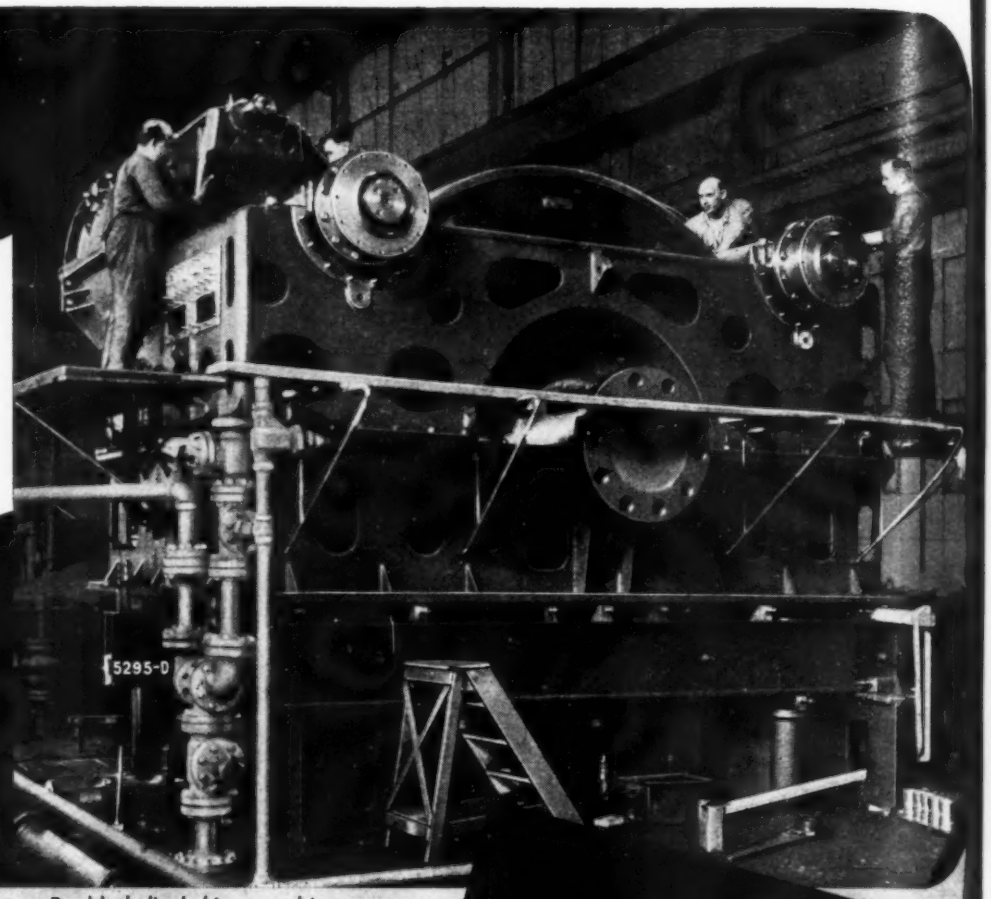


Fig. 1323—Designed for MORE Power — A Class 1500-pound, 14-inch, Cast Steel welding end Gate Valve. It is equipped with top mounted, spring compensated, electric motor operator for quick, positive opening and closing.

VALVES

PARTS ARE GAGED *before and after* THE TEST RUN



Double helical ship propulsion gear on test floor at the De Laval Works

In the De Laval Works each part of a machine is manufactured to limit gages on an interchangeable basis and then, after assembly, the complete pump, compressor, steam turbine or gear is tested under operating conditions to make sure that performance guarantees are met and that the unit is mechanically perfect.

Following the test, the machine is taken down and the parts carefully scrutinized and gaged again, in order to detect any deviation from normal. This practice and policy insures that the purchaser will in every instance receive a correctly built and perfectly operating machine.

M-30

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

MANUFACTURERS OF TURBINES... STEAM, HYDRAULIC; PUMPS... CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS... WORM, HELICAL; and FLEXIBLE COUPLINGS

NOVEMBER
1943

POWER

VOLUME 87
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ON THE Production

WESTINGHOUSE LINK-GRATE STOKERS

Wartime production schedules do not permit "loafing along". Furthermore, coal is whatever you can obtain—not always the grade you have been burning.

LINK-GRATE Stokers have proved ability for maximum performance under these conditions. They burn the available coal, regardless of quality, produce the steam—and stay on the line.

For heavy overload capacity, high availability, quick response to load swings, inherently high combustion efficiency under everyday operating conditions, specify Westinghouse LINK-GRATE Stokers.

Wide distribution over the coal-burning area of the United States—from Maine to Arizona—means there is a LINK-GRATE installation near you. See for yourself. Visit it and check the performance before you choose the coal-burning equipment for your plant. The answers of operators of Westinghouse stokers to your questions are the best proof that Westinghouse LINK-GRATE Stokers will do the job right for your installation.

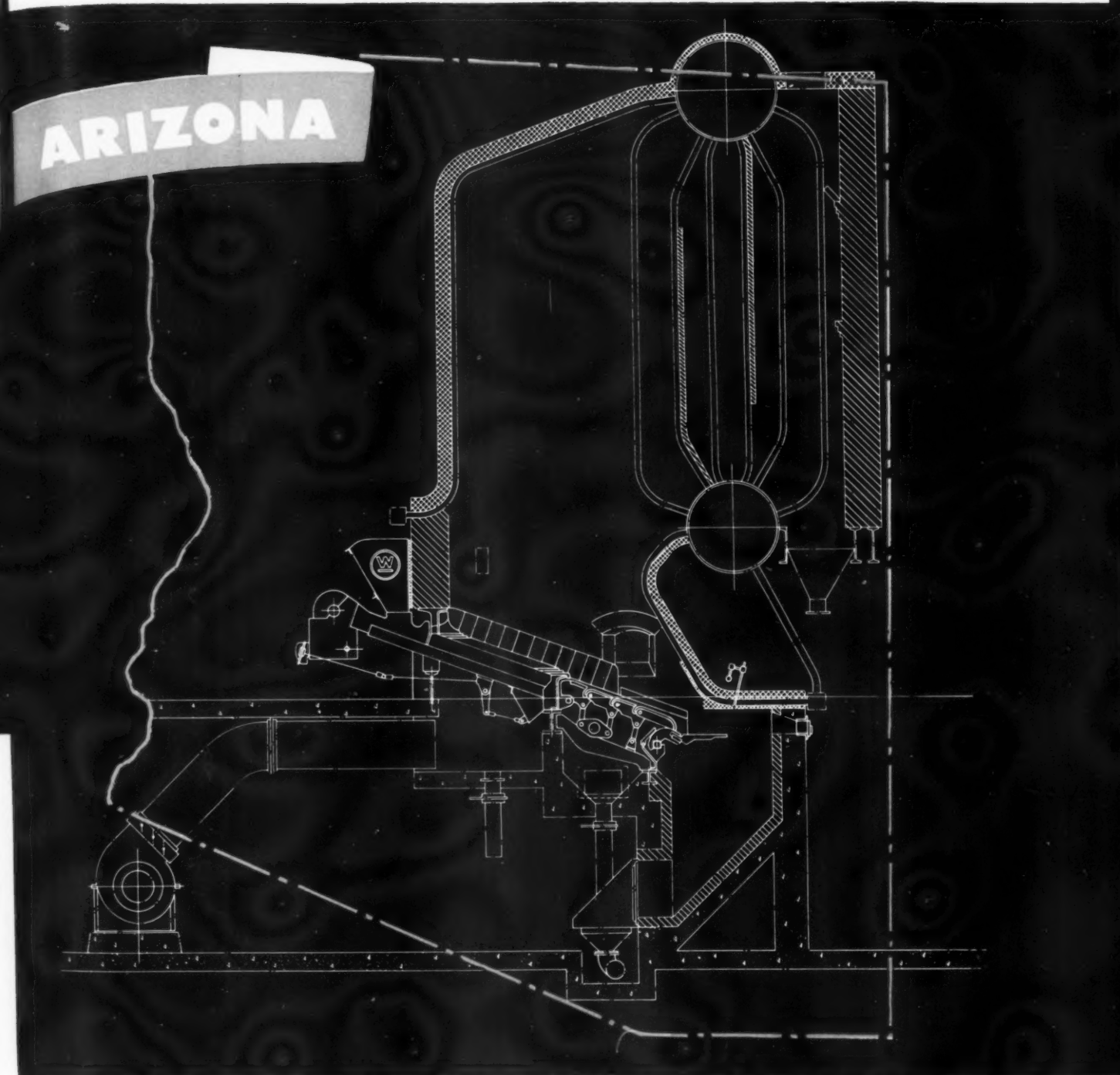
SEE Link-Grate Stokers in operation. Talk with operators and management. Get the performance facts, the economy figures. A Westinghouse representative will arrange a visit. In the meantime, send for these interesting Link-Grate fact books: Bulletin 3039 (multiple retort), 2196-A (single retort). Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N. J-50443

WESTINGHOUSE

Westinghouse STOKERS

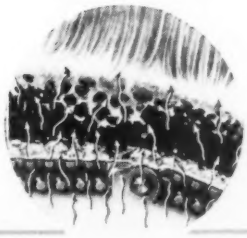
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

Front

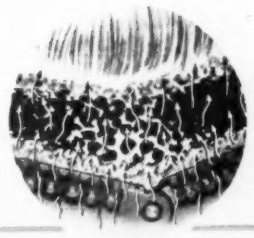


HERE'S HOW THE LINK-GRATE WORKS

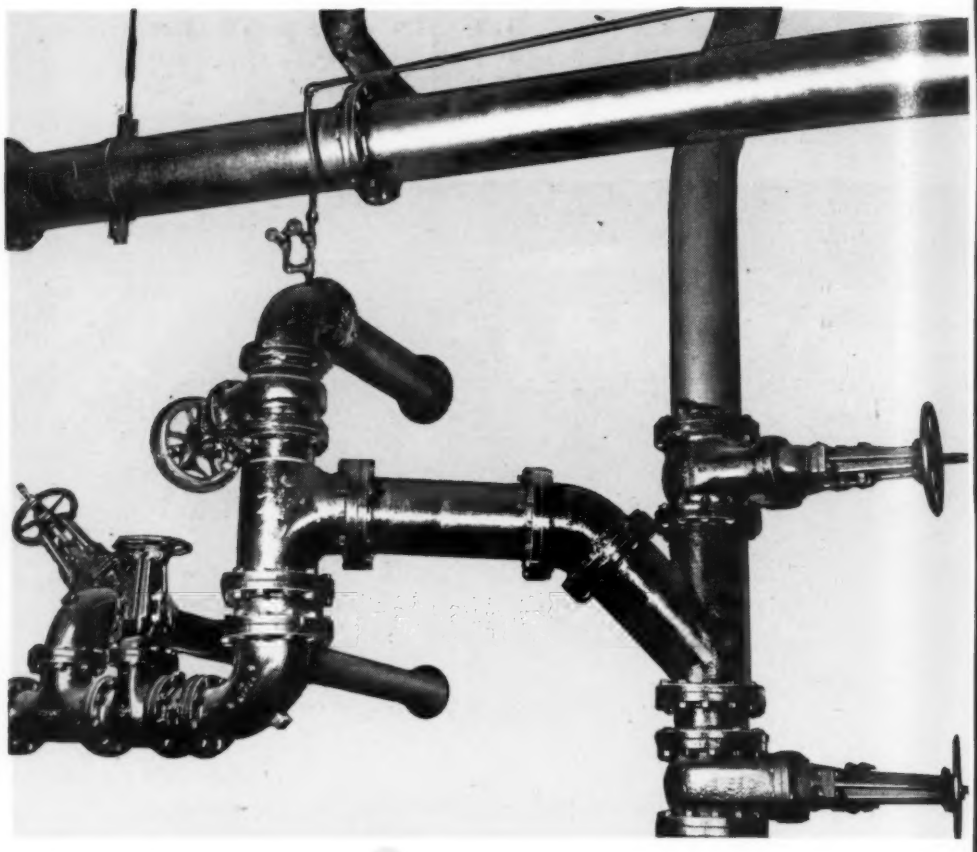
GRATES UP — Fuel bed broken, thoroughly permeated with low-pressure air. Fused ash oxidized, clinkers broken into small, friable pieces.



GRATES DOWN — Fuel bed made porous for uniform flow of gases throughout entire combustion zone —continuously conveyed toward the point of ash discharge.



Here's a water line conservation program in 3 words—



Byers Wrought Iron

The reason proper selection of piping materials is so essential in reducing maintenance is that water is the nearest thing there is to a universal solvent. It tends to dissolve almost everything it touches . . . and the specifiers job is to find what materials will be least affected.

A mineral analysis of a water, with information on the operating conditions, forms a sound basis on which to interpret the corrosive conditions that will be encountered. A wide knowledge of piping performance under such conditions forms a sound basis for selecting materials to withstand them.

Wrought iron has been used with such a variety of corrosive waters, that unusually complete service records are available. Lacking time to exhaustively study each installation, the engineer can safely specify wrought iron pipe as a material capable of meeting a wide range of conditions. As an example: one survey revealed ten installations where wrought iron was still serving after an average life of 46.9 years. The life *to failure* of ten installations of ordinary materials had been 20.2 years.

The reason why wrought iron has made such impressive records is found in its unique structure. Wrought iron consists of high purity iron with tiny threads of glass-like silica slag running through it. These fibers both *oppose* and *deflect* corrosive attack, avoiding pitting, and *anchor* the initial film formed on the metal, protecting the underlying material as a scab protects a wound.

Our Engineering Service Department has specialized from a practical point of view in the study of corrosion and material application problems. They have at hand a large pool of information, including data on water characteristics in various parts of the country, and service records of hundreds of actual installations.

These facilities are available free of charge to those who have a specific problem of applying materials to withstand a particular set of corrosive conditions. If you have any piping jobs in prospect, you will find it helpful to check with our Engineering Service Department or with one of our Field Service Engineers. Ask also for our bulletin, "Wrought Iron in Piping Services."

A. M. Byers Company. Established 1864. Offices in Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

Corrosion costs you more than Wrought Iron

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TUBULAR AND HOT ROLLED PRODUCTS
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POWER

PHILIP W SWAIN, EDITOR ESTABLISHED IN 1882

MEETING THE COAL CRISIS

THE coal situation is getting tough, as Secretary Ickes makes plain in his message to POWER readers on page 93. To get through the coming winter without severe shock to the civilian economy, and even some interference with war work, will take teamwork all along the line—record digging by the miners, some sharing of users' coal piles and the elimination of a lot of needless waste of industrial steam coal.

Here's the situation in brief: Overloaded industry is burning coal faster than ever before in American history, so fast we'll need to boost bituminous production to a record of 690,000,000 tons in 1943 to get by.

But that isn't all: The year's total production is one thing and today's fuel situation is another. Right now there's an immediate bituminous coal pinch for several reasons. Most obvious is the 20,000,000 tons lost in the June strike, followed by a period of limping production. On top of this, both steel plants and Great Lakes industrial consumers have present priority over other users.

In the case of steel, war-swollen production will require far more high-grade coal than the "captive mines" can supply, so steam plants must use more of the leavings.

Up in the Great Lakes, it will be a question of beating the ice that generally blocks water haulage of coal after November 15. Much of this coal simply can't go by rail. Moreover, the shipping season started a month late last spring so that cumulative deliveries are still 3,500,000 tons behind schedule. Until the freeze, lake shipping must get all of the coal it can handle no matter what else has to wait.

Finally, it is common knowledge that rail transportation, which must serve most of the plants of American industry, is loaded almost to the cracking point. These bald facts spell certain inconvenience, and possible trouble, for the industrial consumers of steam coal.

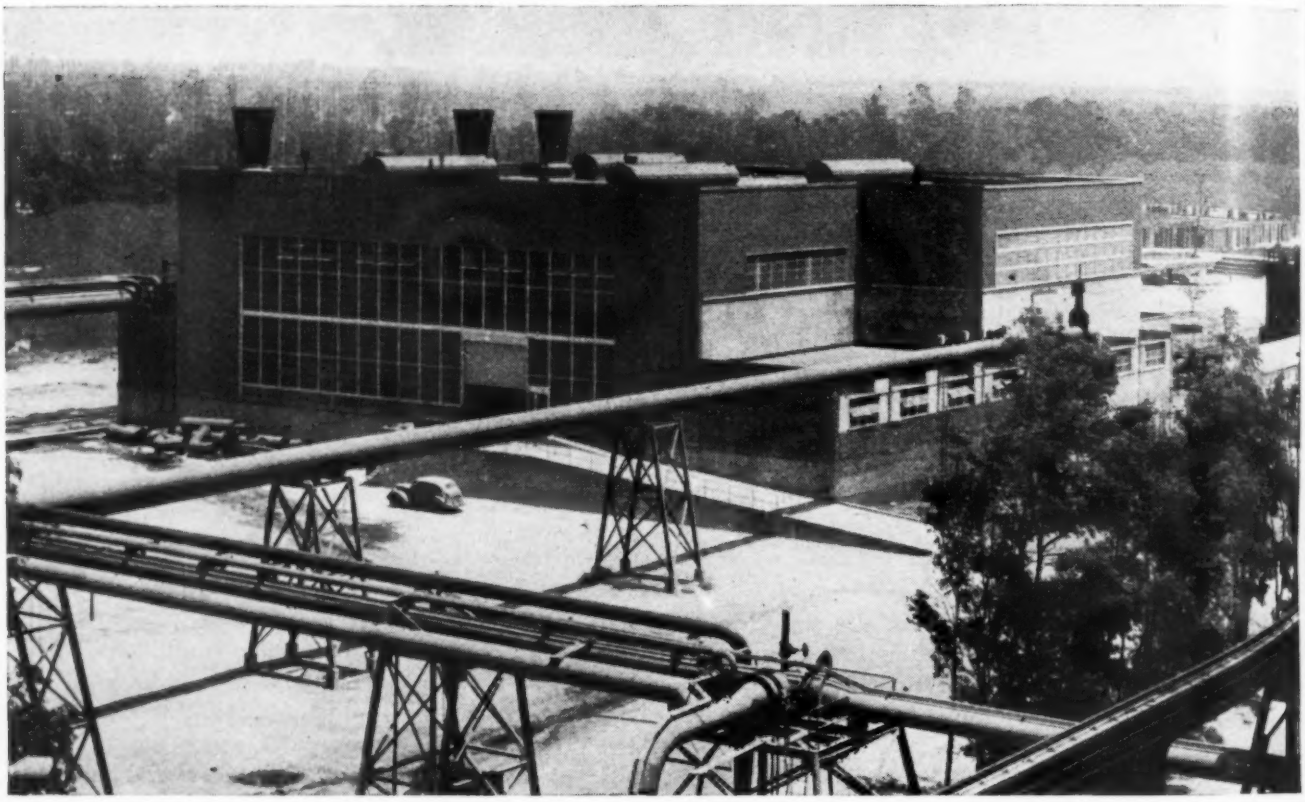
The first aid proposed by the Solid Fuels Administration is to serve the needy with necessary coal while the forehanded plants live off their storage piles. Here and there a plant with plenty of coal may be forced to sell some to a neighbor if the alternative would be an interruption of war production. All this may seem to penalize the thrift and patriotism of those plants that looked ahead and stored in time. "There's a war on—and what else can be done?" is the answer.

With production and distribution handled as well as may be, there still remains one major avenue of relief—both for the individual and the nation—the application of those common-sense fuel-saving measures powerhouse evangelists have been preaching since the year one. Here's where POWER's regular editorial service can be helpful. In particular, we would direct reader attention to an article to be published next month showing many ways to save coal despite wartime restrictions.

Finally, if your plant is in a tight spot for coal, or you'd like technical advice on your fuel problems, note that Mr. Ickes has invited you to lay your troubles (in full and in writing) before the Solid Fuels Administration, which may be addressed at the New Department of Interior Building, Washington, D. C.

STEEL FOR A WESTERN EMPIRE

Just a year ago Fontana, Calif., raised fruit and pigs. Now Kaiser's steel mill rolls ship plate among vineyards and orange groves. Associate Editor Tucker sends in this first-hand report of the only West Coast boilers burning blast-furnace gas



Blast-furnace and coke-oven gas piping leads into, and air line out of, power plant set amidst orange and walnut groves

▶ EIGHT MONTHS from a standing start, pig iron began to pour from the blast furnace of the first integrated steel mill west of the Rockies. Now, less than a year later, the iron and steel division of Kaiser Co, Inc, speeds openhearth steel plate the less-than-50-miles distance to coast shipyards.

If you have business there, you are welcomed by an efficient staff into a modern one-story office building surrounded by flowers, green lawns, groves, orchards and even vegetables. Farther away the desert blooms only where irrigation reaches. About the only water this steel mill lets get away in liquid form goes toward growing fruit and produce for the company cafeteria and for sale in the open market.

Raw materials come from nearby sources making the mill practically independent of Eastern supply. Ore averaging 52% iron (Fe) is strip mined at Kelso, Calif., some 175 miles from the mill. Other high-grade deposits within a radius of 300 miles are known to be ample to supply the blast furnace for many decades to come. Limestone is quarried within ten miles of the mill now, and many other accessible deposits are available within a short distance. Dolomite comes from southern California and nearby Nevada, as does manganese. California affords no satisfactory supply of coking coal; rail haul from the Sunnyside Mines of eastern Utah is, however, only about 700 miles.

A visitor is immediately impressed by the complete mechanization of materials handling. Hopper cars dump to an inclined belt which takes ore to crusher and screen house. Fines are reclaimed for sintering while the main bulk of ore proceeds directly to hoppers near the blast furnace or bypasses to open storage piles. No steam lines to thaw frozen cars and storage piles in southern California!

Coal also is elevated to the crusher house by belt conveyor. A Bradford breaker reduces run-of-mine to 1¾-in. size; then a hammer mill pulverizes to about 50% through a ⅛-in. screen.

Two batteries of 45-oven Koppers-Becker under-jet coke ovens each have a capacity of 900 tons of coke a day, charging about 1700 tons of coal. A larry loads the individual ovens from the top taking its supply from an 1800-ton storage tower. Each oven holds a 14-ton charge in a space 14-in. wide, 40-ft long and 14-ft high. Coking period averages 18 hours.

A side-dump car carries glowing coke to a quenching tower which requires about 800 gallons of water per

oven charge. Quenched coke is distributed along nearly 100 ft of 45-deg cooling slope from where it is admitted to a belt conveyor through control gates. After screening, coke proceeds by belt conveyor to blast-furnace storage while fines are returned to the sintering house for fusing to a porous clinker with fines from ore screening and residue from the dust collectors.

Coke-oven gas of 580 Btu per cu ft at about 550 F passes through a scrubber and desulphurizing tower followed by a Cottrell precipitator before entering the blower which delivers the gas to by-product recovery and to fuel use. Spraying with ammoniacal liquor in the tower recovers some 9000 tons of ammonium sulphate annually for fertilizer.

Byproduct Recovery

The byproduct recovery plant can turn out 1½ million gallons of benzol annually for synthetic rubber or solvent use, as well as 400,000 gallons of toluol for TNT and 300,000 gallons of xylol and naphtha. Close to four million gallons of creosote oil and 750,000 gallons of residue fuel oil are produced. Some 18,000 tons of pitch are put back into the coke ovens and 250,000 tons of blast-furnace slag can be utilized for road ballast or for making rockwool.

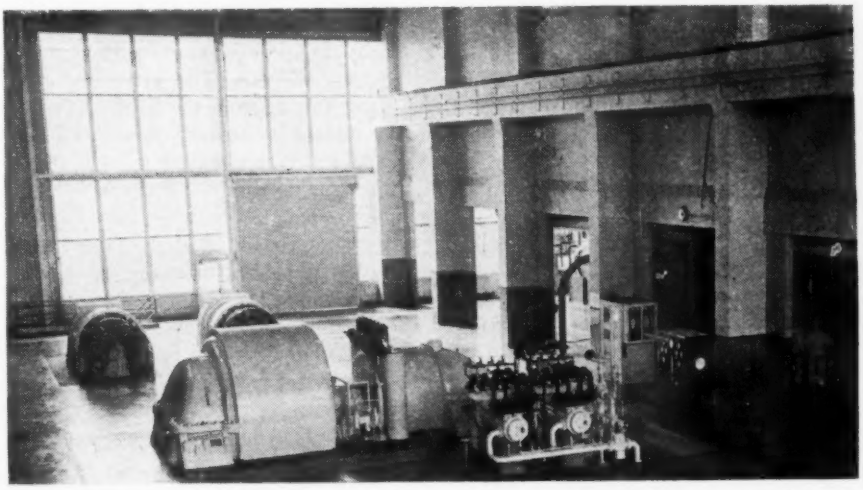
The single blast furnace is rated at 1200 tons of pig iron a day but has produced over 1300 tons in a 24-hr period. Raw materials are weighed into a two-car balanced skip hoist for transfer to the furnace. Blast-furnace gas with a heat content of about 90 Btu per cu ft passes through a dust catcher, scrubber and a pair of Cottrell precipitators before being used as fuel for the three hot-blast stoves that preheat combustion air to 1800 F. Excess gas is burned under the power-house boilers. Since dust particles are almost completely removed from both coke-oven and blast-furnace gas, stack solids emission from the entire steel-making operation is reduced to a minimum. Kaiser has taken every precaution to protect the surrounding fruit-growing and agricultural lands from dust blanketing.

Iron is tapped directly into 150-ton torpedo ladles for charging to the open hearths. Excess over steel requirements is shunted to a continuous pig-casting machine from which pigs fall into open-top railroad cars.

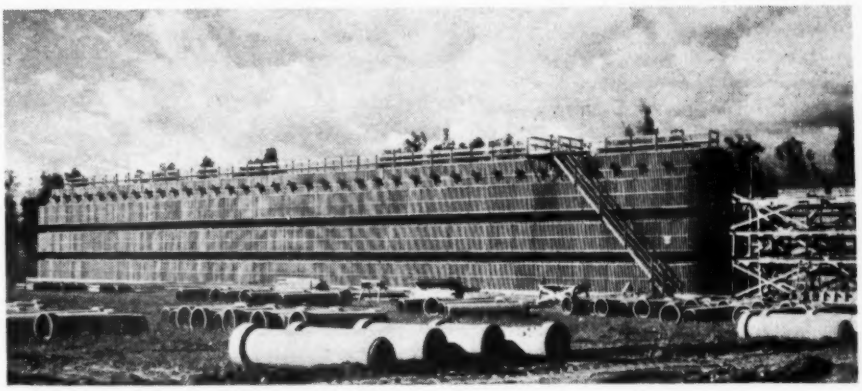
Six open-hearth furnaces have a rated ingot capacity of 675,000 tons annually. Four are now in operation and the remaining two will be completed shortly. They are fired by coke-oven gas enriched with residue fuel oil.

Tapped into 200-ton ladles, steel is cast into ingots by bottom pouring, although some top-poured stock is being made on special order. After stripping, ingots proceed to the adjacent plate-mill soaking pits or are diverted for sale in the open market.

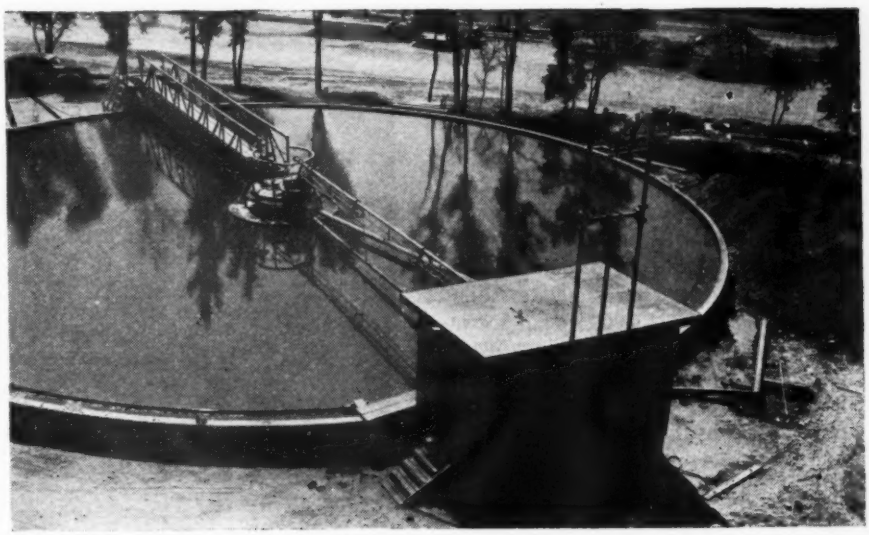
The two-high roughing mill is driven by two General Electric 3500-hp 750-volt dc motors, one direct connected to the lower roll and the other to the upper roll, coupled through a universal joint. The three-high finishing mill is powered by a single G E 7000-hp 750-volt dc motor of special design with a speed range of 40-120 rpm. Table



"Full wind" means 100,000 cfm at 30 psi from this turbo-blower. Note open wall to the boiler room at the right and dc motor-generator sets in the background



One of several large cooling towers that serve the mill water systems as well as the power house. Practically no water leaves the plant as waste liquid



This Dorr thickener is part of a complete system of water reclamation and treatment. The city water supply is supplemented by the output of two deep wells

rolls are controlled by amplidynes.

The plate mill can turn out thicknesses from ¼-in. to 2-in. and sizes up to 110-in. wide and 50-ft long. Finished plate is leveled and sheared to size on adjacent tables.

A separate 36-in. breakdown 28-in. structural mill and a 14-in. merchant mill are under construction in separate buildings close by the plate mill. The merchant mill will be able to handle alloy shapes and bars to meet almost any specifications. Future plans call for production of electric-furnace steel as well as open hearth.

Power Purchased

Electric power load, now running a demand of about 10,000 kw on over 40,000-hp of connected equipment, is purchased from Southern California Edison at a rate close to 7 mills per kwhr. A three-way 69-kv supply linked to the Edison central distributing point assures continuity of power service to the Kaiser-owned substation on the steel-mill property. Distribution within the plant, principally through underground single-conductor lead-covered cable, is at 6900 volts.

The steam plant boasts of the only blast-furnace-gas-fired boilers west of the Rockies. Three Babcock & Wilcox integral-furnace units supply 400-psi 700-F steam to either of two 100,000-cfm Ingersoll-Rand turbo-compressors and to yard use. Normal blast-furnace-gas supply is supplemented when necessary by coke-oven gas or fuel oil under Askania automatic control. Bailey controls regulate feedwater and steam-flow air-flow ratio. Steam for yard supply is reduced to 175 psi and desuperheated to 425 F. The system serves blast furnace, coke plant, etc.

The first turbo-compressor is rated at 11,500 hp when producing 100,000-cfm of 30-psi air. The second, more recently installed, delivers the same quantity at the higher pressure of 35 psi with a nominal 12,500 hp. Both units exhaust to Ingersoll-Rand condensers served by a Fluor induced-draft cooling tower. A Fuller 2-stage 600-rpm rotary compressor supplies general air requirements at 100 psi.

Each 166,000-cfm Sturtevant induced-draft fan is driven by a 400-hp Elliott turbine geared 3840/960 rpm. A two-speed motor, arranged in dual drive, provides standby. The 65,000-cfm forced-draft fans have 160-hp geared-turbine drives backed up by single-speed motors.

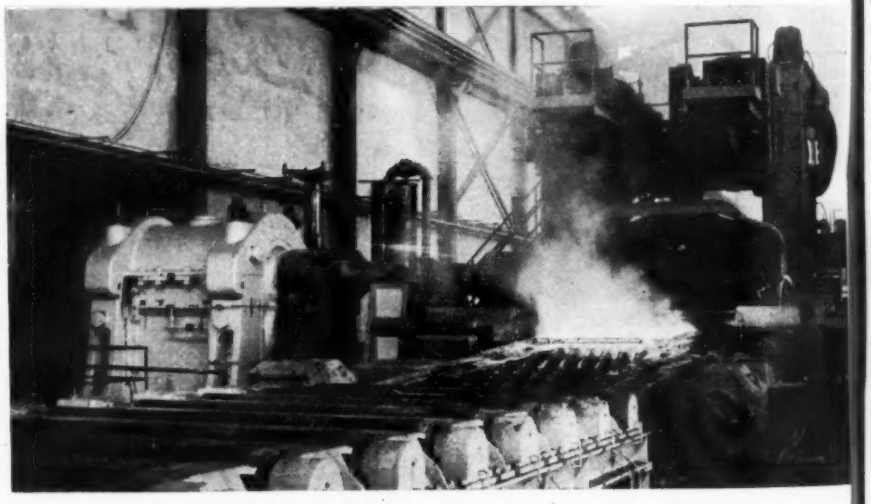
Transformers and switching equipment for yard supply of 2300-volt and 440-volt ac are located in the power house. Motor generators furnish 250-volt dc for cranes and other special-purpose drives.

Because occasional dust storms would bring silica into the air intakes, blast-furnace air is cleaned by two Westinghouse precipitron electrostatic dust collectors. Another smaller unit removes solids from the sintering-furnace gas before it enters the i-d fan.

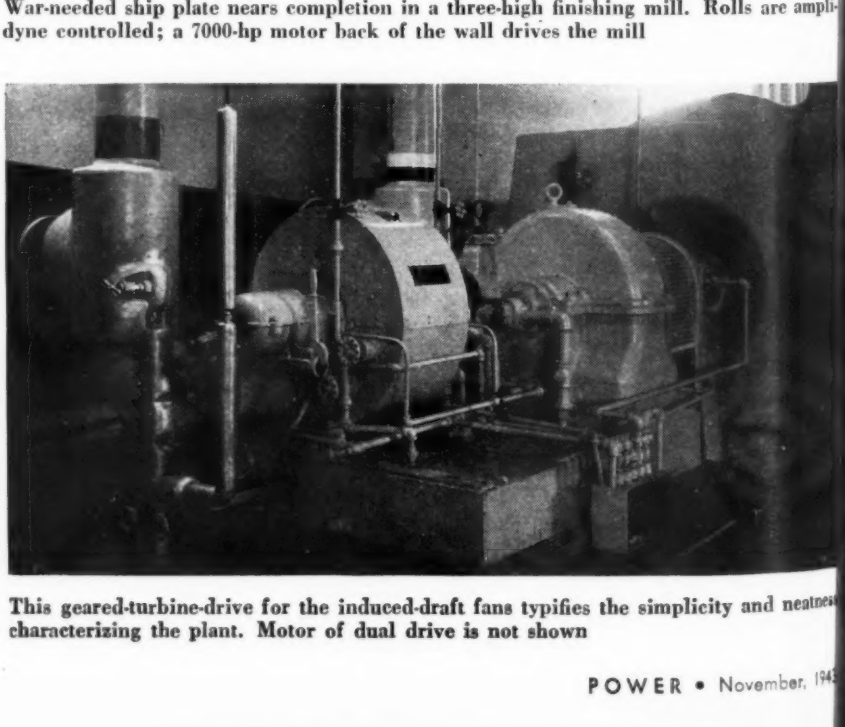
Unlike most steel mills, Fontana is located in desert country with no nearby stream or lake. The plant derives its water supply from the local system, fed by distant mountain streams of limited capacity. Water conservation is evident throughout every operation. Power-plant condensers circulate to a cooling tower as do the heat exchange operations of the blast furnace. All domestic water from the office, cafeteria and mill, even the effluent from the sewage-disposal plant, returns to an "industrial" water system which is continually clarified by a Dorr treatment plant and filters. The only water not reclaimed is that used for coke quenching, roll cooling and the pig-casting machine.

Surrounding the 600 acres of mill area are 730 acres of cultivated land belonging to the Kaiser enterprise. Some 96 acres of vineyards, 150 acres of walnuts, 23 acres of yams, 12 acres of blackeyed beans, 5 acres of corn, 15 acres of citrus, 400 acres of hay and grain, 5 acres of tomatoes, 2 acres of potatoes and 18 acres of truck garden lend an atmosphere never before associated with steel making. Agricultural products not only pay their own way, including the care of extensive landscaping and profusion of flowers, they afford a net profit while assuring Kaiser workers of adequate fresh food supply.

While the Kaiser mill has been built as a "war baby" to supply ship plate and munitions, it is obvious that the plant has been designed as a permanent, economical operation that can serve as a postwar nucleus of a West Coast industrial empire.



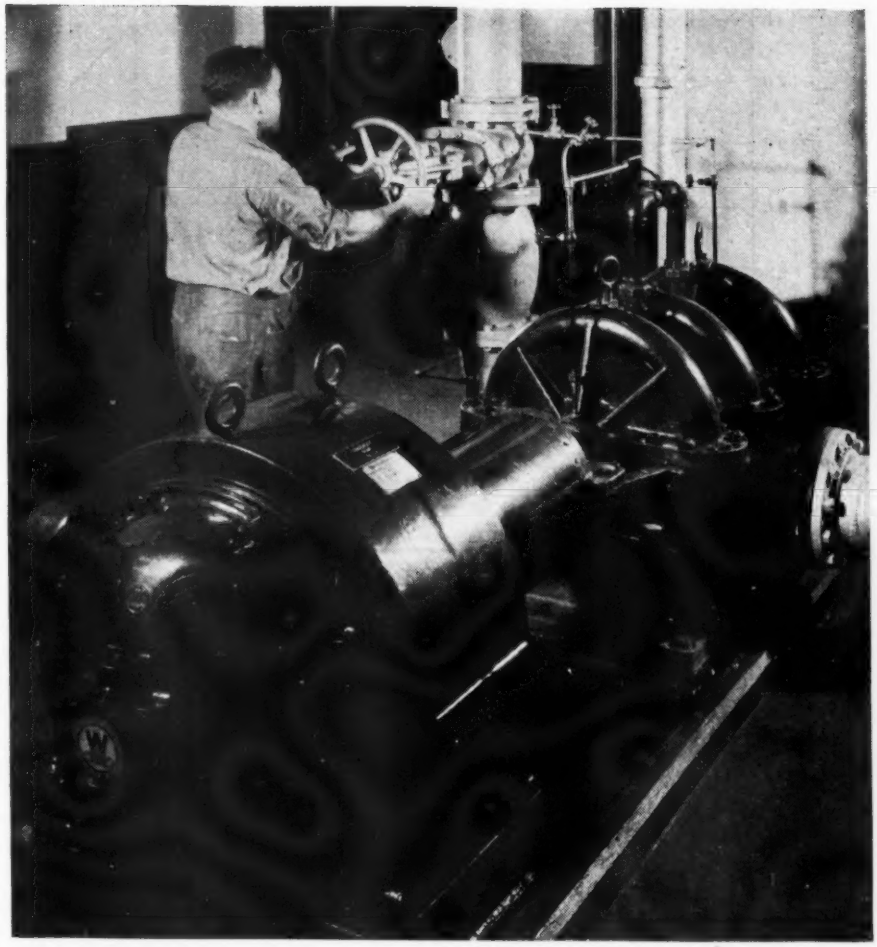
War-needed ship plate nears completion in a three-high finishing mill. Rolls are amplidyne controlled; a 7000-hp motor back of the wall drives the mill



This geared-turbine-drive for the induced-draft fans typifies the simplicity and neatness characterizing the plant. Motor of dual drive is not shown

How to Tailor Centrifugal Pumps to Fit New Applications

When you do not have a centrifugal pump with the correct characteristics for a given application, here's what you may do to make an available one suitable for the job, as told by Frank Kristal, pump engineer, who knows all the tricks of the expert



A centrifugal pump can be adapted to a wide range of heads and capacities by throttling or by changing speed or impeller diameter, or by a combination of these

▶SOME PLANTS not directly engaged in war work may find it almost impossible to buy new pumps today, no matter how necessary they may be. Engineers should, therefore, analyze available pumps to adapt them to a given job, or try to buy and adapt used pumps to their needs. Whether used pumps are on hand or purchased, the plant engineer must have their characteristic curves and know their impeller diameters before he can make changes in them intelligently. He must also have a knowledge of the laws that govern centrifugal-pump performance, all of which are comparatively simple.

Capacity and Head

Capacity and head of a centrifugal pump depend on its speed and its impeller diameter and width. At constant speed, pump capacity decreases as the head increases with a decrease in power input, according to the shape of the pump's head-capacity curve. These curves vary in shape for different pump designs, but they approximate *A* and *B*, Fig 1. Head-capacity curve *A* is for a pump with 14.25-in. impeller, 2.5-in. discharge, and capacity of 400 gpm at 175-ft head, point *C*, at which it requires 24.5 hp input, point *D*. If head on this pump increases to 198 ft its capacity decreases to 300 gpm, point *E*, and power to drive the pump decreases to less than 22 hp, point *F*. On the other hand, if head decreases to 137 ft, point *G*, pump capacity increases to 500 gpm and power to 27 hp, point *H*.

All this sums up to: Output of a centrifugal pump may be controlled within certain limits by throttling the discharge. Do not completely close the discharge valve because the pump, operating as a water brake, would then absorb the entire power input, and the water would soon be raised to a temperature that would injure the pump. However any centrifugal pump should operate satisfactorily with a reasonable amount of throttling of the discharge to control its output.

Impeller diameter and its speed are two other elements that plant engineers may change to alter head and capacity of a centrifugal. In these factors a centrifugal pump's characteristics vary according to these rigid laws: At a given speed, pump capacity varies directly as impeller diameter, head varies as impeller diameter squared, and power to drive the pump varies as impeller diameter cubed. With a given impeller diameter, pump capacity varies directly as the speed, head varies as the speed squared and power input to the pump varies as the speed cubed.

Having the characteristic curves of a given pump and knowing its impeller diameter or speed, we may readily calculate impeller diameter or speed for a different set of characteristics based on the above laws. Generally the manufacturer can furnish the characteristic curves from data on the pump nameplate, and impeller diameter may be measured by opening the pump.

Impeller Diameter

Assume the pump has the full-line curves of Fig. 1. It has a 14.25-in. impeller and operates at 1750 rpm, as already stated. If we wish to use it under conditions where a 175-ft head

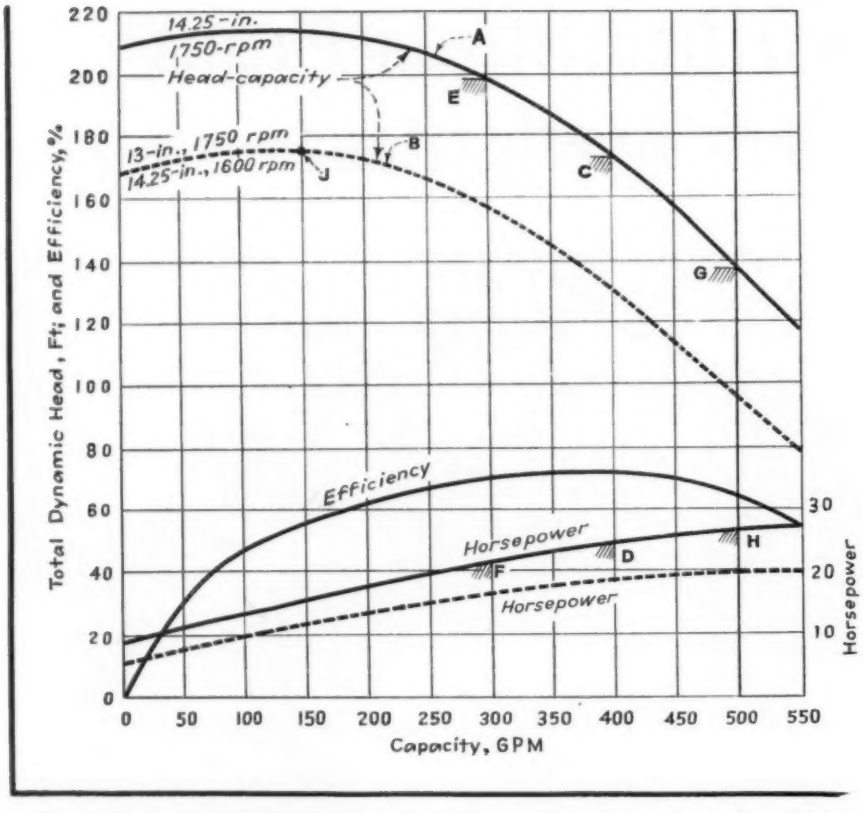


Fig. 1—Reducing impeller diameter from 14.25 to 13 in. lowers its head-capacity

and 150-gpm discharge are needed what can we do to meet these requirements?

First, we can throttle the discharge to obtain the desired flow, but the pump will develop 214-ft head and require about 15 hp input. If the pump is to be in service a good part of the time, it will probably be objectionable to operate it throttled because of power losses, possibilities of cavitation, or other undesirable effects. To avoid these, see what can be done by reducing the impeller diameter. The correct diameter to develop 175-ft head at 150 gpm is found by the formula

$$d = \sqrt{h \times D^2 \div H},$$

where d and D equal the required and original diameters, respectively, of the impeller, and h and H equal the required and original heads, respectively, developed by the pump. The original head $H = 214$ ft, the required head $h = 175$ ft, and the original impeller diameter, $D = 14.25$ in. Then, the required impeller diameter is

$$d = \sqrt{175 \times 14.25^2 \div 214} = 12.9 \text{ in.},$$

say 13 in., because it is best to leave the impeller a little oversized. Then if it develops too much head it can be put back in the lathe and its diameter reduced a little more. Whereas, if the impeller is too small, nothing much can be done about it.

Knowing the impeller diameter for one point on the new head-capacity curve, we determine other points by transposing the impeller-diameter formula to read;

$$h = d^2 \times H \div D^2$$

At 300 gpm the 14.25-in. impeller develops 198 ft head, then the 12.9-in. impeller develops

$$h = \overline{12.9^2} \times 198 \div \overline{14.25^2} = 157 \text{ ft head}$$

Several points for the curve are obtained by this formula and the head-capacity curve plotted for the new impeller diameter. The problem, however, can be made simpler than this.

Impeller Diameter

After calculating size of impeller, place a point on the curve sheet where the new head and capacity line intersect, as at *J*, Fig 1. Then draw a curve through this point, parallel to the original curve, as shown. This dotted curve represents head-capacity characteristics of the new impeller closely enough for all practical purposes.

Reducing the impeller diameter simply reduces the head it will develop at any point along the original head-capacity curve. Then to get a head-capac-

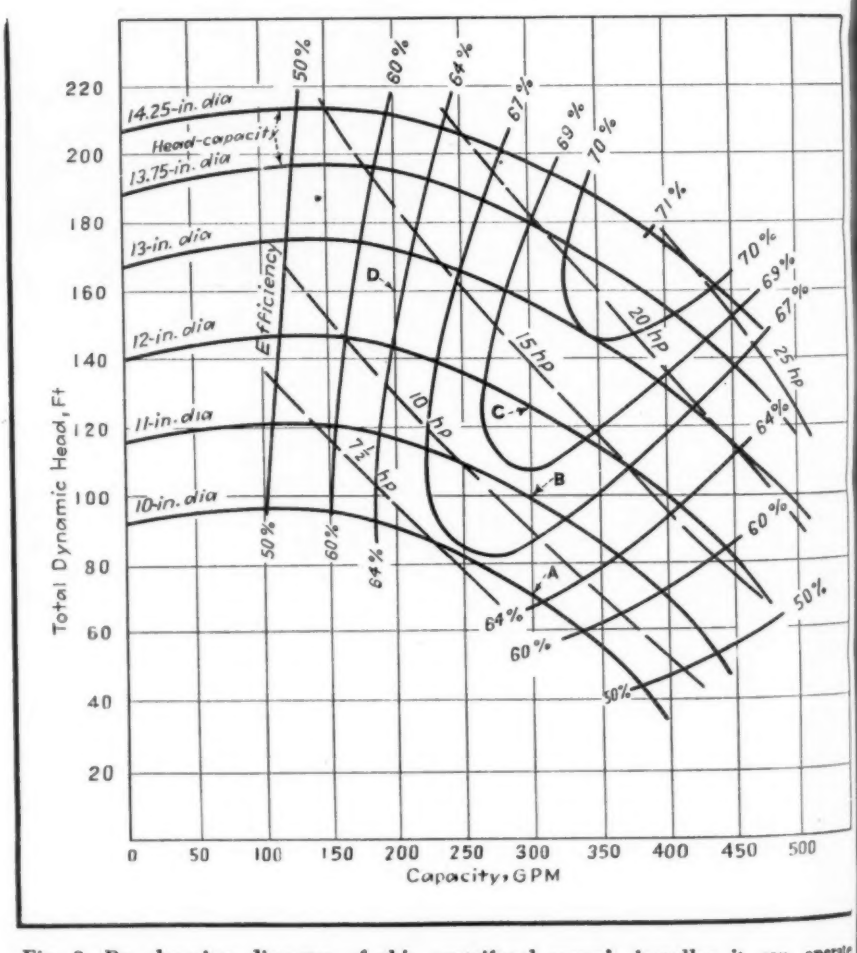


Fig. 2—By changing diameter of this centrifugal pump's impeller it can operate at any head and capacity falling within area covered by these curves

ity curve for the new runner diameter we need only move the original curve down to some point representing a given head and capacity and calculate impeller diameter to give this characteristic. This is all we did to obtain the 13-in. impeller head-capacity curve, Fig 1.

Power required to drive the pump is calculated by the formulas:

$$Hp = \frac{GPM \times H}{3960 \times E}$$

where H equals the head under which the pump operates and E its efficiency. At any given discharge the pump efficiency remains about the same for any diameter impeller, within working limits. Therefore, at 150 gpm the 13-in. impeller has about the same efficiency as the 14.25-in. one, or, as shown in Fig. 1, about 54%. The head is 175 ft; then

$$Hp = \frac{150 \times 175}{3960 \times 0.54} = 12 \text{ hp}$$

With a 14.25-in. impeller and throttled to a 150-gpm discharge, the pump requires 15 hp. By reducing the impeller diameter we save 3 hp, or 2.25 kw, which, in one year's operation of 8 hr per day, 300 days per year, amounts to 5400 kwhr. At 2 cents per kwhr, the saving is $108, in addition to eliminating the bad effects of operating the pump throttled.

Fig. 2 shows a family of characteristic curves for a pump similar to the one in Fig. 1. Note that the head-capacity curves for the different-sized impellers have practically the same shape and are parallel. In other words, reducing impeller size reduces the head that the pump can develop in an equal amount throughout its head-capacity range.

Efficiency and Power

Superimposed on the head-capacity curves are the efficiency and horsepower curves, but this does not complicate their use. For example, take 300-gpm discharge. The 10-in. impeller develops a head of 70 ft at this discharge, point *A*. Going up to the 11-in. impeller we find that it develops about 98-ft head, point *B*. Similarly the 12-in. impeller is good for 125-ft head, point *C*; the 13-in. impeller, 156-ft head, the 13.75-in. impeller, 179-ft head, and the 14.25-in., 198-ft head.

Point *A* on the 10-in. impeller curve is slightly above the 64% efficiency curve, which shows that at this point the pump has a little better than 64% efficiency. On the 11-in. impeller curve, point *B* falls about half way between the 67 and 69% efficiency curves; consequently the pump has an efficiency of about 68%. In similar manner, efficiency of the other impellers may be read from the curves.

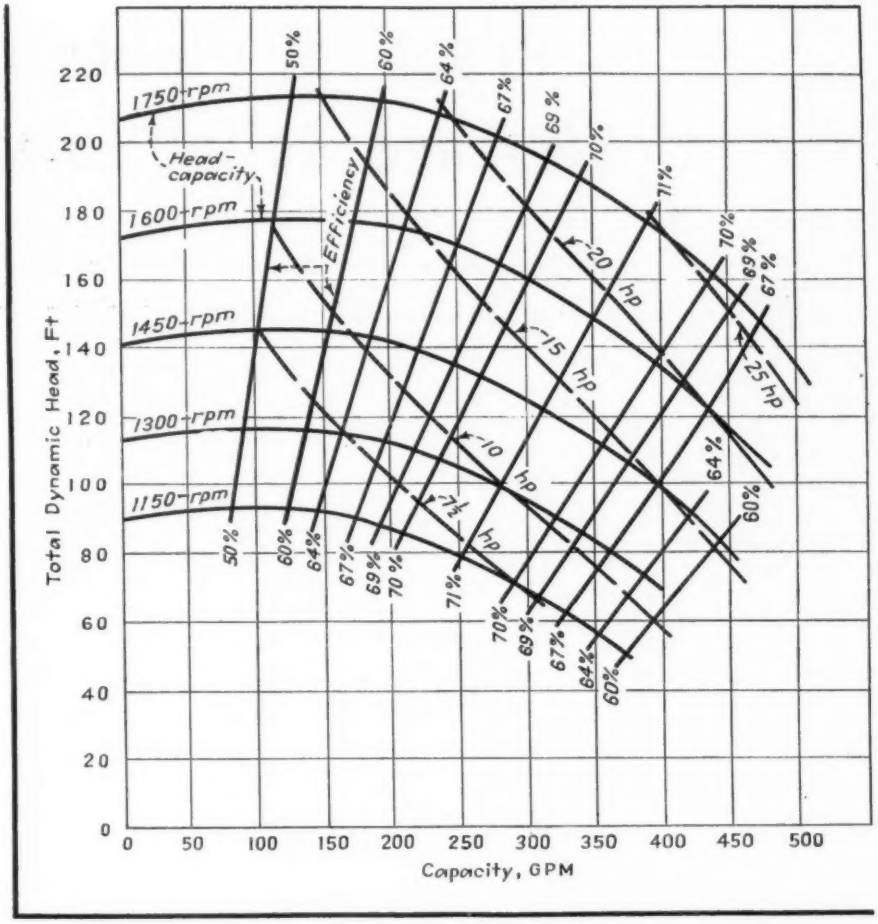


Fig. 3—Characteristic curves from a centrifugal pump with a 2.5-in. discharge, and a 14.25-in. impeller when operated over a speed range of 1750 to 1150 rpm

Point *A* on the 10-in. impeller curve falls between the 7.5- and 10-hp curves in a position that shows the pump requires about 8.5 hp to drive it. On the 11-in. impeller curve, point *B* falls between the 10- and 15-hp curves at about 11 hp. Point *C* on the 12-in. curve indicates about 13.5 hp needed to drive the pump. Thus, it is evident that these curves show pump performance with different-sized impellers.

We do not have to select the size impeller shown in the figure as long as we stay within the limits of a 14.25-in. and a 10-in. impeller. For example, assume we want an impeller for 200 gpm at 160-ft head, point *D*. This falls about half way between the 12- and 13-in. impeller curves. Then, we would select a 12.5-in. impeller and the manufacturer would supply a pump with this size.

Changing pump speed also changes its head-capacity characteristics, just as changing impeller diameter does. Fig. 3 shows a family of head-capacity curves obtained by testing the pump at five different speeds with the 14.25-in. impeller, Fig. 2. In Fig. 3 the 1750-rpm curve is the same as the 14.25-in. impeller curve, Fig. 2, as they should be because both have similar impellers, operated at 1750 rpm.

Speed Changes

In Fig. 2 and 3, the 13-in. impeller curve and the 1600-rpm curve are practically the same. This indicates that the 14.25-in. impeller operating at 1600 rpm has about the same head-capacity characteristics as a 13-in. impeller operating at 1750 rpm. Likewise, the 1450-, 1300- and 1150-rpm curves, Fig. 3, correspond closely to those for the 12-, 11- and 10-in. impellers, respectively, in Fig. 2. When the speed of a pump can be readily adjusted, it is the most convenient and efficient way of adjusting its head and capacity. Having the head-capacity curve of a pump at one speed, we readily calculate the head-capacity curve at a higher or lower speed by the formula:

$$s = \sqrt{h \times S^2 \div H}$$

where s and S represent required and original speeds, respectively. Assume that the pump is represented by the head-capacity curve, Fig. 1, at a speed of 1750 rpm and we want to operate it

(*Continued on page* 140)

Practical Pointers on Wartime Boiler Operation

Abstracts from a comprehensive talk* by Alfred Iddles, Babcock & Wilcox Co, show how to keep tube surfaces clean, prevent tube-seat and handhole leakage, and repair failed tubes

► SLAGGING AND SOOT ACCUMULATION play an important part in boiler operation. Yet slag on convection surfaces need cause no trouble in a modern well-designed unit because standard practice provides wide tube spacing and ample cooling surface ahead of the convection surface. But in war time, trouble may result from loads beyond design capacity or exceptional fuel not intended for the boiler.

Available mechanical devices remove slag in almost any form, and so-called soot blowers meet nearly all conditions. There are, however, some closely spaced tube banks from which no blower can remove ash accumulation. On some boilers the only remedy for this capacity limitation lies in better fuel, improved combustion conditions, or periodic outages for hand cleaning.

In the last few years, designers have greatly improved mechanical cleaning devices by applying a large amount of steam for a short time, which is more effective than the same quantity over a longer period. This means so-called *mass* blowers either of the ordinary soot-blower element type, with multiple nozzles far enough from the tubes so that high mass flows can be tolerated without cutting, or retractable single nozzles of the type which project into the furnace when needed, either just through the wall or progressively across the furnace opposite the convection surface to be cleaned. These retractable blowers use steam, air or water, and will apply the cleaning fluid forcefully and progressively across the unit.

Mass Soot Blowing

Most operators are familiar with these devices. Emphasis here is upon the good work resulting from the great force and commotion produced by short-time use of cleaning fluid. Fig. 1 shows a typical mass-blower spacing which permits large quantities of high-pressure steam for short blowing periods, and Fig. 2 illustrates a typical retractable single blower and one type of installation.

One simple admonition may help a great many boiler operators. A soot blower usually uses steam, always stands by for hours, and then is in service for only a few minutes. Even a steel-tube blower element can be damaged if condensed steam from the pipeline is blown into it when hot. Much greater damage results if an element is made of high-chromium alloy, such as is used wherever gas temperature is about 1600–1900 F.

The answer, of course, lies in having soot-blower piping so arranged that a valve drains away the condensed steam as the piping heats up. Be sure that this valve is used before steam is admitted to the blower elements.

Fuel choice directly affects operation, particularly with respect to slagging. The responsible operator should have a cooperative arrangement with the purchasing agent so that wherever possible fuel shall be as suitable as possible. Experience and trial build up a knowledge of fuels that give trouble and those that are satisfactory. When it is necessary to go to new sources, determine operating characteristics by trial before awarding a contract for new fuel. This is a joint problem for management and operators because existing equipment probably has distinct limitations which it is unwise to ignore if more satisfactory fuels are obtainable.

Tube-Seat Leakage

Tube-seat and handhole leakage may prove a nuisance in any plant aiming for maximum production. Tubes rolled into seats in drums or headers remain tight after proper installation provided normal expanding power of the tube, which keeps it in contact with the tube seat, is unimpaired. Seat design and hardness and elasticity of tubes and

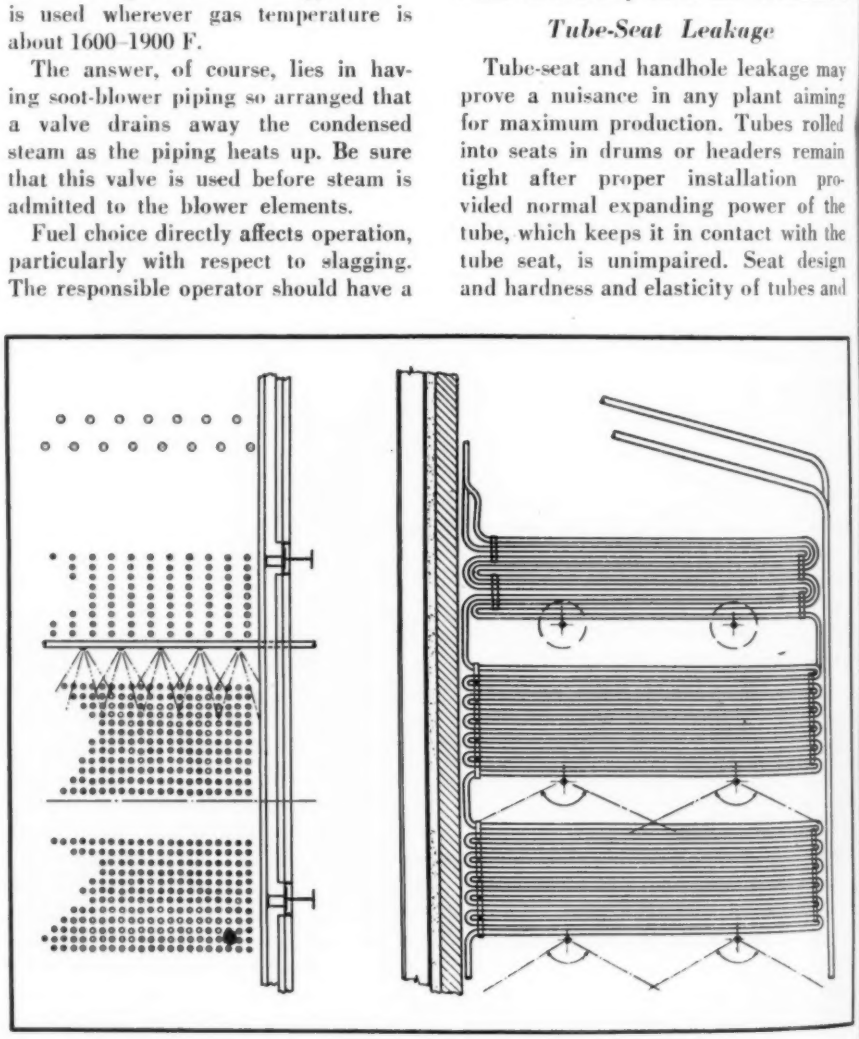


Fig. 1—Mass blower spacing, as shown above, permits use of large quantities of high-pressure steam for relatively short periods of soot blowing

* Mr Iddles' original paper, "War and How to Keep Boilers Steaming," presented at the annual meeting of the Minnesota Federation of Architectural and Engineering Societies, covers the entire field of boiler operation and maintenance in thoroughgoing fashion. The above abstract of several sections holds particular interest for POWER readers.—Editor

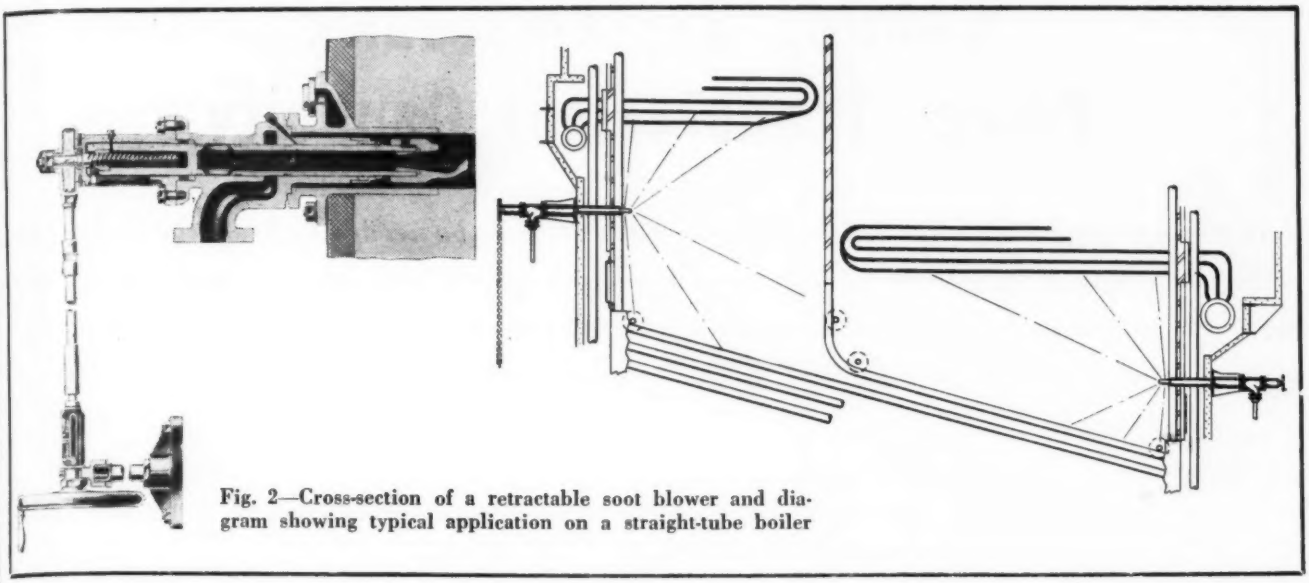


Fig. 2—Cross-section of a retractable soot blower and diagram showing typical application on a straight-tube boiler

seats provide a tight joint against the pullout force because of pressure, and the normal slight tendency of tubes to bend under expansion.

But the tightness disappears if the tube should, for instance, shrink because it is cooled rapidly while in a tube hole surrounded by warmer metal in the drum or header. This means that the temperature of the boiler should be known when filling or emptying it. Do not put cold water in a relatively hot boiler; rather, let water come from the feed lines at temperature as nearly that of the boiler metal as possible.

When a boiler is being fired and some steam pressure has developed, tightening the handhole stud nuts, sometimes two or three times during pressure raising, takes up for heat expansion. If well and carefully done such a precaution avoids many leaks and possibly a shutdown for retightening. Sometimes corrosion shows up first in handhole seats, particular inspection for which should be made at every outage where caps are removed.

Even with the best of care, boiler tubes occasionally fail. Today it is entirely feasible to make many repairs by welding, which has developed greatly in the last few years, both in technical and metallurgical phases and also in available skill needed. The usual procedure involves cutting out that portion of the tube which has failed and adjacent portions which are damaged. Machine the tube ends for a proper welding groove, place a backing ring on the inside of the tube at the weld, and make the weld in place. Sometimes it is necessary to bend tubes out of a wall or out of a bank of adjacent superheater tubes but in the majority of cases the weld can be made without removing other tubes. Fig. 3 illustrates the repair steps.

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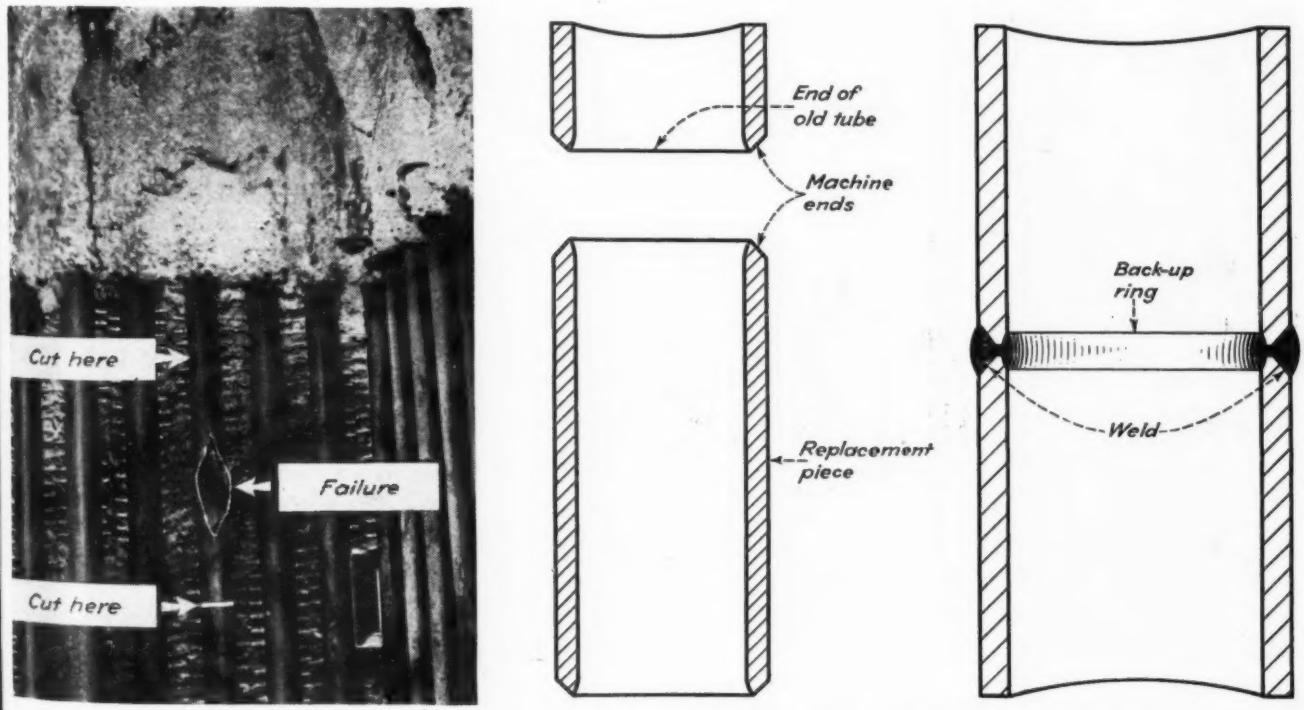

Fig. 3—Method of repairing a failed tube in place by welding. Photo at left shows tube and location of cuts; diagram in center shows preparation of tube end and replacement piece; finished repair, with back-up ring in place, is shown at right

Cooling Systems Jump Power-Transformer Capacity

Today every bit of safe power capacity, and some more, may be needed to keep war production at its peak. How a knowledge of transformer cooling systems may help you find a lot of badly needed kilowatts and how much increase in capacity you can expect to obtain to meet present heavy load demands is told by W C Sealey, transformer engineer, Allis-Chalmers Mfg Co

► TRANSFORMERS are among the most efficient electric power units, with full load losses as low as one percent of their rated output. Losses appear as heat in the core iron and copper windings and must be removed at a rate that will keep transformer temperature within safe limits.

Cooling may be by one of several systems. *Dry-type* transformers are cooled by either natural-air or forced-air circulation over core and coils. *Oil-immersed* transformers are cooled by three systems: self-cooled by natural-air circulation over tank and radiator surfaces; cooled by forced-air circulation over cooling surfaces; cooled by forced-oil circulation through air or water coolers. *Oil-immersed water-cooled* transformers are cooled by circulating water through pipe coils immersed in the insulating oil in the transformer tank.

No matter what the cooling system, heat is dissipated from transformers by conduction, radiation and convection. Size and design determine the part each plays in the cooling job, as the following examples show.

Dry-type transformers. Fig. 3 shows a section of a small unit. When it is loaded, heat generated in the copper winding *A* flows by conduction to the outside surface of coil *B* from where it is dissipated to the surrounding air by conduction and to adjacent objects by radiation. The heated air rises over the coil surfaces and permits cool air to rise and take its place, as the arrows indicate. The fresh air in turn is heated as it passes over the coils and carries away the heat. Temperature difference between *A* and *B* varies in different commercial transformers.

Usually less than one half of the total heat is dissipated by radiation, the amount depending on the area of the smooth surface envelope. Making the coils larger increases the amount of heat given off by radiation. This, however, is not a practical or efficient method of increasing the cooling for dry-type transformers. A better method is to increase the heat dissipated by convection by exposing a larger area of coils and core to the air. In dry-type transformers this is done by providing vertical air-cooling ducts between the coils, as in Fig. 4.

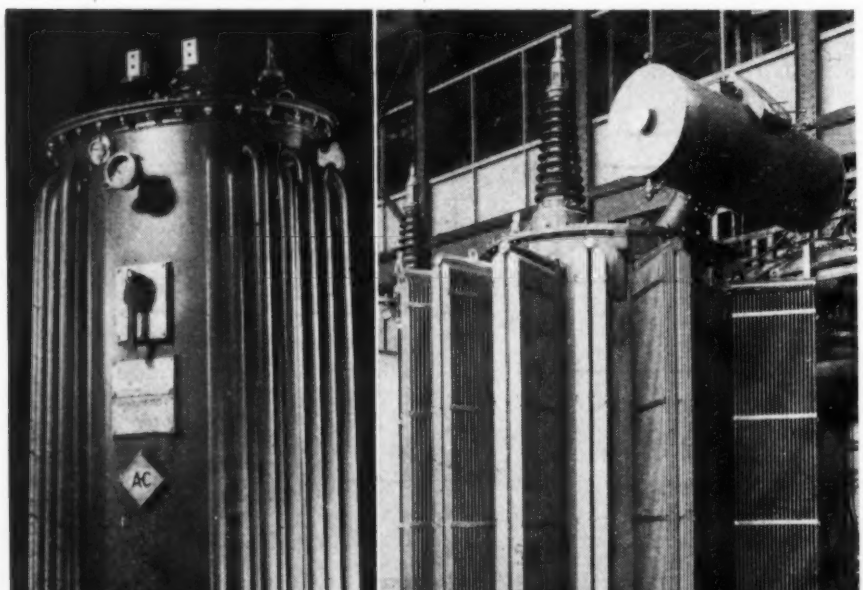

Fig. 1—Tubular tanks increase transformer capacity and require but a small increase in floor space. Fig. 2—Radiators, an effective means of increasing transformer-tank cooling surface, are commonly used for transformers above 1000-kva capacity

Forced-Air Circulation

Heat transmitted from coils to a fluid such as air must first pass by conduction through an air film, on the coil surface, which gives the surface a higher temperature than that of the adjacent air. Forced circulation of air, for example with a fan, seems to decrease the air-film thickness and reduce its resistance to heat flow. Therefore, increased rate of dissipation results from a given temperature rise.

With forced-air circulation, the difference in temperature between the bottom and top of the coils also becomes less because the faster the cooling air flows, the more frequently it replaces the heated air. This decreases the temperature at the top of the coils (reduced hot-spot temperature), and gives practically the same results as an increased rate of heat dissipation over the whole

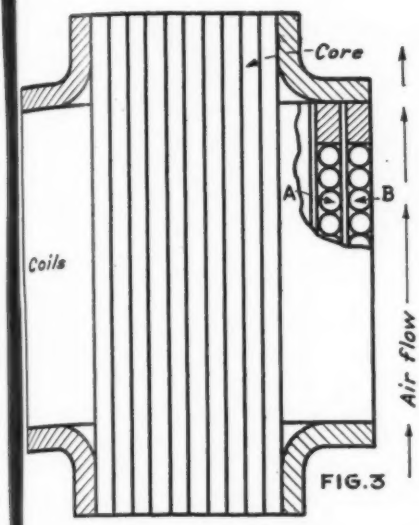

FIG. 3

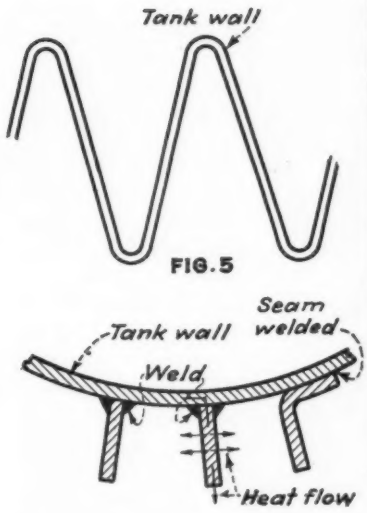

FIG. 5

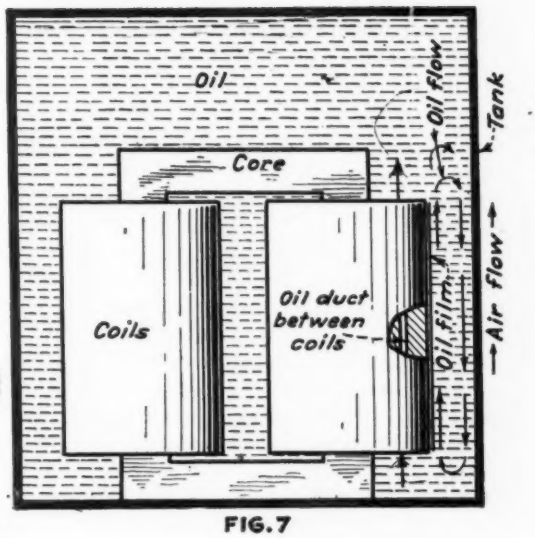

FIG. 7

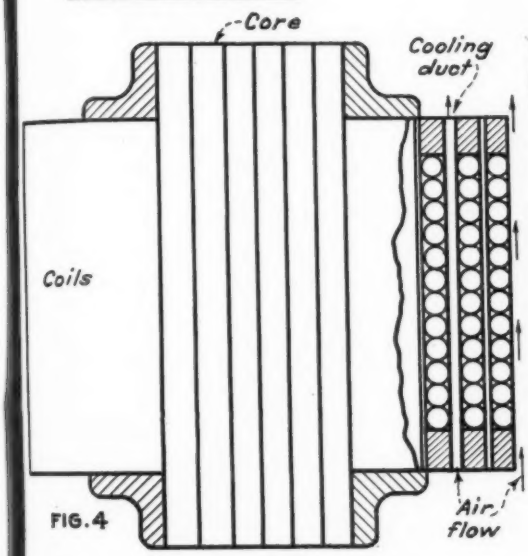

FIG. 4

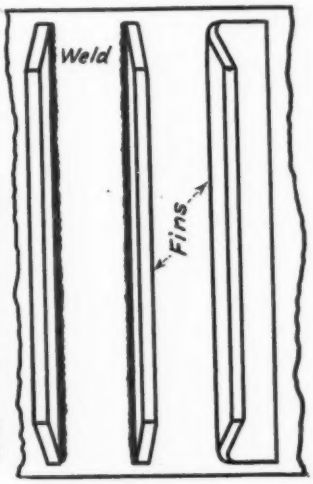

FIG. 6

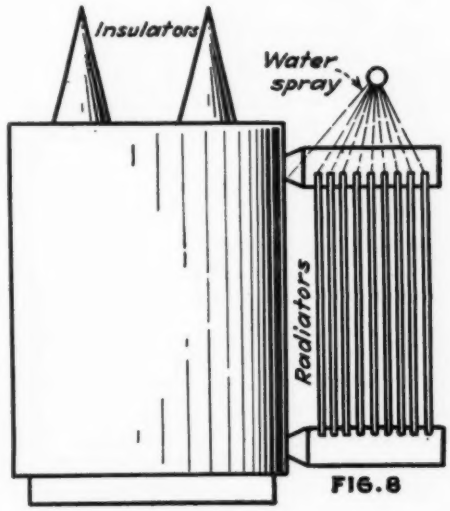

FIG. 8

Fig. 3—Section through small dry-type air-cooled transformer. Fig. 4—To increase cooling surface of dry-type transformers, vertical ducts are provided in their coils for increased air circulation. Fig. 5 and 6—Capacity of oil-immersed transformers is increased by installing them in plain tanks with fins welded on the outside or in corrugated tanks. Fig. 7—Oil-immersed transformers in plain tanks, up to about 50-kva capacity, have sufficient exposed surface to dissipate heat generated in their coils and core. Fig. 8—A water spray may increase capacity of self-cooled transformers as much as 60%

coil, even though the temperature at the coil bottom may remain the same.

Dry-type air-cooled transformers without air ducts are practicable only for units of a few kilovolt amperes rating, whereas transformers with air ducts are built in capacities up to approximately 2000 kva. When fans for forced-air cooling are added, a dry-type transformer can readily be constructed for any desired rating.

Oil-immersed transformers. Many designs use oil for insulation and cooling, as in Fig. 7. Heat generated in the coils is transmitted by conduction, first to the outer coil surface and then through an oil film into the oil itself. The oil flows over the tank surface where the heat is transmitted from it by conduction through the tank metal to its outside surface. Here the heat dissipates by radiation to other objects and by conduction through the air film to the air itself. The heated air moves away by convection; cool air then comes in to take its place, absorb heat and move away in turn.

Cooling Area Per Kilowatt

Oil-immersed transformers, in plain tanks up to approximately 50-kva capacity, have sufficient exposed surface to dissipate heat generated in their coils and core. The tanks have approximately 20 sq ft of cooling surface for each kilowatt of heat loss dissipated. If they cannot dissipate heat rapidly enough, fins, corrugation, tubes or radiators are added to provide additional tank surface as follows:

Fins are welded to the tank, Fig. 6, and increase its surface area to where it dissipates the heat from transformers up to about 100-kva rating. Fins conduct heat away from the tank wall, and also increase the heat dissipation rate by convection because they project into the air and increase the smooth-surface envelope. Because of the large temperature drop through the fins as they conduct heat, their outer edges are cooler than their inner. Consequently, they provide a small increase in effective surface only, so that approximately 60 sq ft of fin surface is required to dissipate one kilowatt of heat loss.

A corrugated tank has a zigzag or similar shaped wall, Fig. 5. The larger area thus presented to the air increases the heat dissipation rate by convection while only slightly increasing transmission by radiation. Increase in effective tank surface from corrugations is limited. The deeper the flutes, the less efficient the heat dissipation be-

cause deep flutes restrict air circulation. Approximately 50 sq ft of corrugated surface is required for each kilowatt of heat loss dissipated. Corrugated tanks are not now generally used because tubes or radiators more effectively increase tank surface area and are readily applicable.

Welded-on tubes. Fig. 1, increase transformer-tank cooling surface and require only a slight increase in floor space. Tubes may be round, flat or oval in cross-section, round ones being the most common. If one row is insufficient, two, three or even four rows are used. More than three are seldom installed because of decreased cooling efficiency and difficulty of maintaining the inner rows. Increased cooling surface, possible with tubes, is limited by tank circumference; they are used mainly for transformers below 4000-kva capacity. Approximately 40 sq ft of tube surface dissipates one kilowatt of heat loss.

Radiators Applied to Tanks

Radiators, an effective means of increasing tank cooling surface, are commonly employed for transformers above 1000-kva capacity, Fig. 2. They increase the rate of heat dissipation by convection by increasing the smooth-surface envelope of the transformer and by radiation as well. If the tank cannot accommodate the required number of radiators, they may be placed on headers, as in Fig. 9. About 45 sq ft of radiator surface dissipates one kilowatt of heat loss.

Fans arranged to blow air over the radiators increase their heat dissipation rate, the amount of air supplied being ordinarily from 100 to 250 cu ft per min per kilowatt of heat loss dissipated. Fans usually increase heat dissipation from radiators less than 100%, values of 50 to 75% being more common. Transformers of 3333-kva capacity and above usually have their kva rating increased 33% by fans blowing over their radiators. Each kilowatt of heat loss dissipated by forced-air cooling requires approximately 30 sq ft of surface.

To increase their rating, more and more self-cooled transformers are bought with forced-air cooling, and it is also added to existing transformers to take care of increased loads. Forced-air cooling is not used on plain tanks without radiators or tubes because it increases their heat-dissipating capacity but slightly. They dissipate a considerable portion of the heat by radiation which is not affected by increased air flow. Furthermore, a plain surface dissipates heat efficiently by natural convection, which increases only slightly by added air flow.

Another method of increasing self-cooled capacity, involves spraying water on the transformer's cooling surfaces and on the cooling air, keeping all cooling surfaces wet, Fig. 8. Rate of heat dissipation can be several times that of natural-convection cooling, depending on water and air temperatures and humidity. This method may increase capacity as much as 60%, but because it is messy and deteriorates the paint, it is used mainly for emergency operation.

Forced-oil cooling is the most efficient system in common use, Fig. 10. A pump circulates the oil through a heat exchanger which dissipates the heat from the hot oil to the air or to water. An oil-to-air heat exchanger consists of cooling tubes brazed in a header, with fins extending in the air to produce additional surface area over which the air circulates. An oil-to-water heat exchanger is smaller and more compact.

Oil Temperatures

In self-cooled transformers, average oil temperature in the radiators is often 18 F below hottest oil temperature and average air temperature frequently 18 F higher than that of the coolest air. In such transformers the rate of heat transfer from oil to air is roughly proportional to the difference between their average temperatures.

With forced circulation of oil and air, average oil temperature may be only 5 F below that of the hot oil and the average air only 9 F above that of the coolest air. Under these conditions the

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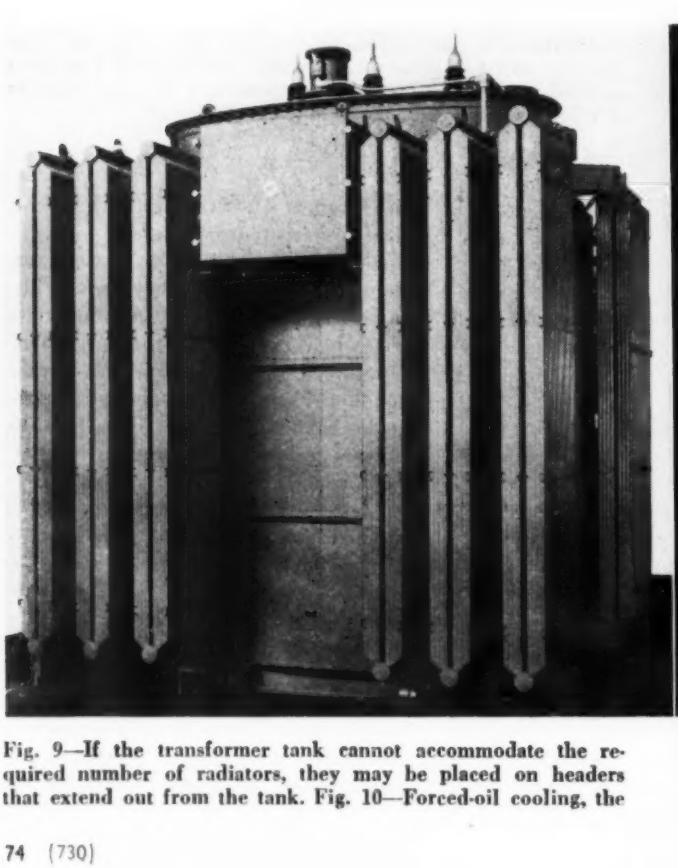

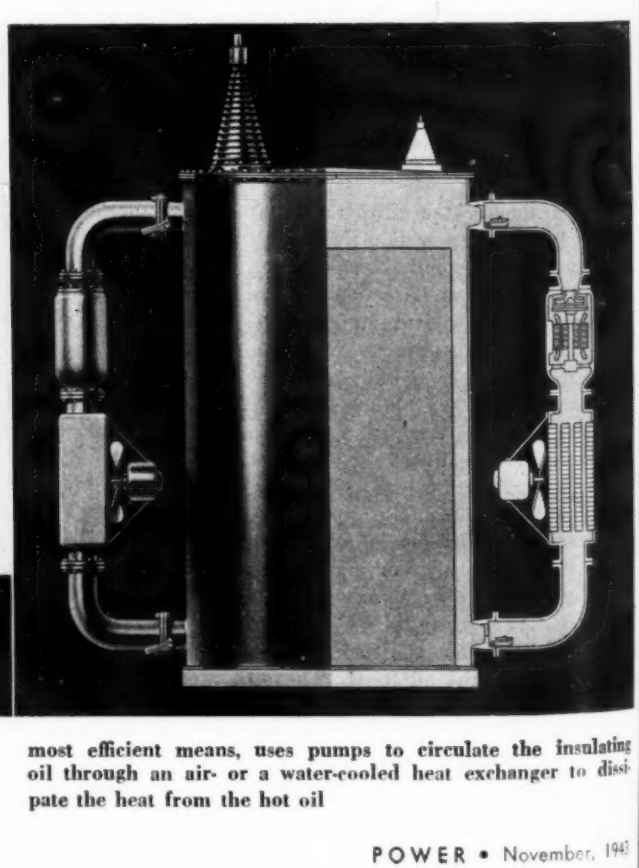

Fig. 9—If the transformer tank cannot accommodate the required number of radiators, they may be placed on headers that extend out from the tank. Fig. 10—Forced-oil cooling, the most efficient means, uses pumps to circulate the insulating oil through an air- or a water-cooled heat exchanger to dissipate the heat from the hot oil

There's a Diesel Starting System to Fit Your Plant's Needs

To help select the method best suited to local conditions, here's a summary of the way the six basic systems of engine starting operate

▶LIKE THE FAMILIAR automobile engine, the diesel requires starting power from an outside source. To meet the varied needs of big and small engines, stationary and portable units, and diesels connected in various ways to driven equipment, designers have worked out many starting systems. Compressed-air starting is perhaps the commonest, followed by the various forms of cranking —electric motor, gasoline engine, air motor, motorized generator and manual. Let's look at what it takes to start a diesel, how the various methods work, and where each finds its widest application in power practice.

Whatever the starting method, the engine must turn over at a speed high enough to cause ignition in the cylinders. This speed should run at least 10–15% of normal and be higher for engines with small cylinders. Low surrounding-air temperatures make starting more difficult; the usual solution provides some means of heating intake air, engine jackets, or both. Some engines are equipped with a glow plug to heat the combustion space and others have arrangements for relieving compression. Size of the flywheel also influences starting; a large one helps particularly in compressed-air starting and in manual starting with compression relief.

In compressed-air starting systems, air at about 250 psi enters the cylinders under control of starting-air valves, providing the "push" that brings the engine up to starting speed. Stationary and nonreversible marine engines usually have air valves on two or three cylinders out of the total.

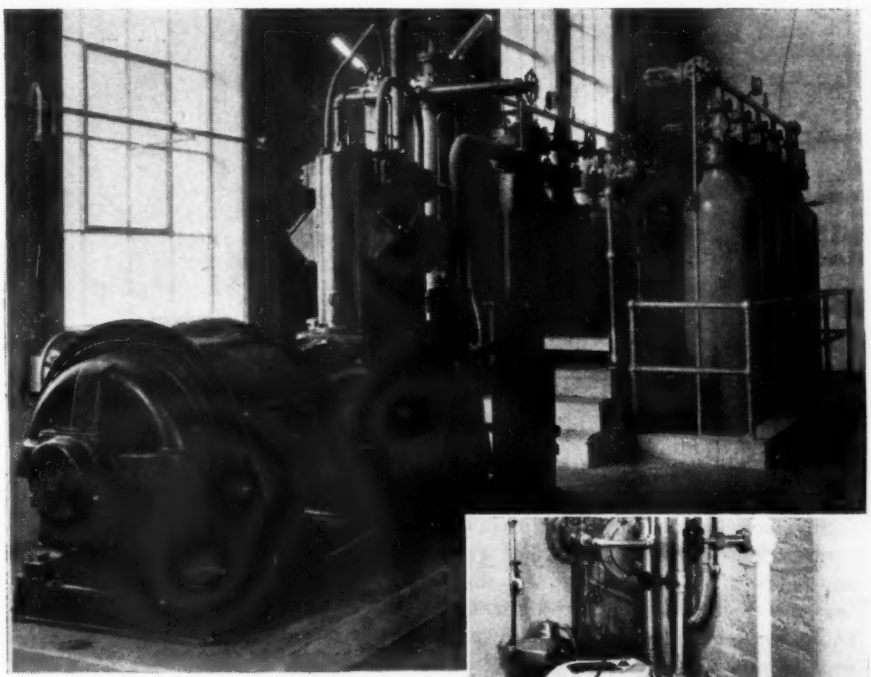

Fig. 1 (*above*)—Motor-driven starting-air compressor and two batteries of air tanks in a large diesel station

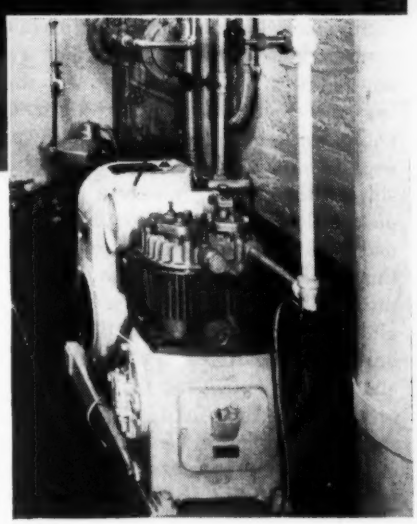

Fig. 2 (*right*)—Small gasoline-engine compressor set in a New England industrial diesel plant provides emergency starting. A separate motor-driven compressor takes care of normal charging. In many plants, a single compressor, with both gasoline engine and motor drive, handles the entire job.

Procedure for Starting

This keeps to a minimum the number of cylinders chilled by expansion of starting air and thus makes starting easier. Prompt starting of engines fitted with only a few air valves requires barring over to make sure that the cylinders with starting valves receive air in proper order and that the crank of the cylinder to get air first stands about 15 deg past top center. If equipped with starting valves on every cylinder, 4-cycle engines with six or more cylinders, and 2-cycle units with two or more, start from any crank position. On direct-reversing marine engines, a full complement of starting valves insures prompt response when maneuvering.

On most engines, starting air enters the cylinder through a check valve, with separate valves or a distributor to control quantity and timing of air admitted. Fig. 3 shows a typical example of each scheme.

Timing of the system on the left originates in a cam-operated pilot valve. Air from the manifold holds the pilot valve against its seat until the starting cam raises it, permitting air to flow to the main air valve in the cylinder head. This valve includes a balance piston; air pressure from the manifold working against the piston holds the air valve shut until overbalanced by entrance of pilot air to the space above the piston.

The arrangement at the right, Fig. 3, typifies designs using a distributor instead of cam-operated valves. Driven by the camshaft, the distributor plate admits air to each starting valve in sequence. The latter are simple spring-loaded check valves. Manual operation of the main starting-air valve admits

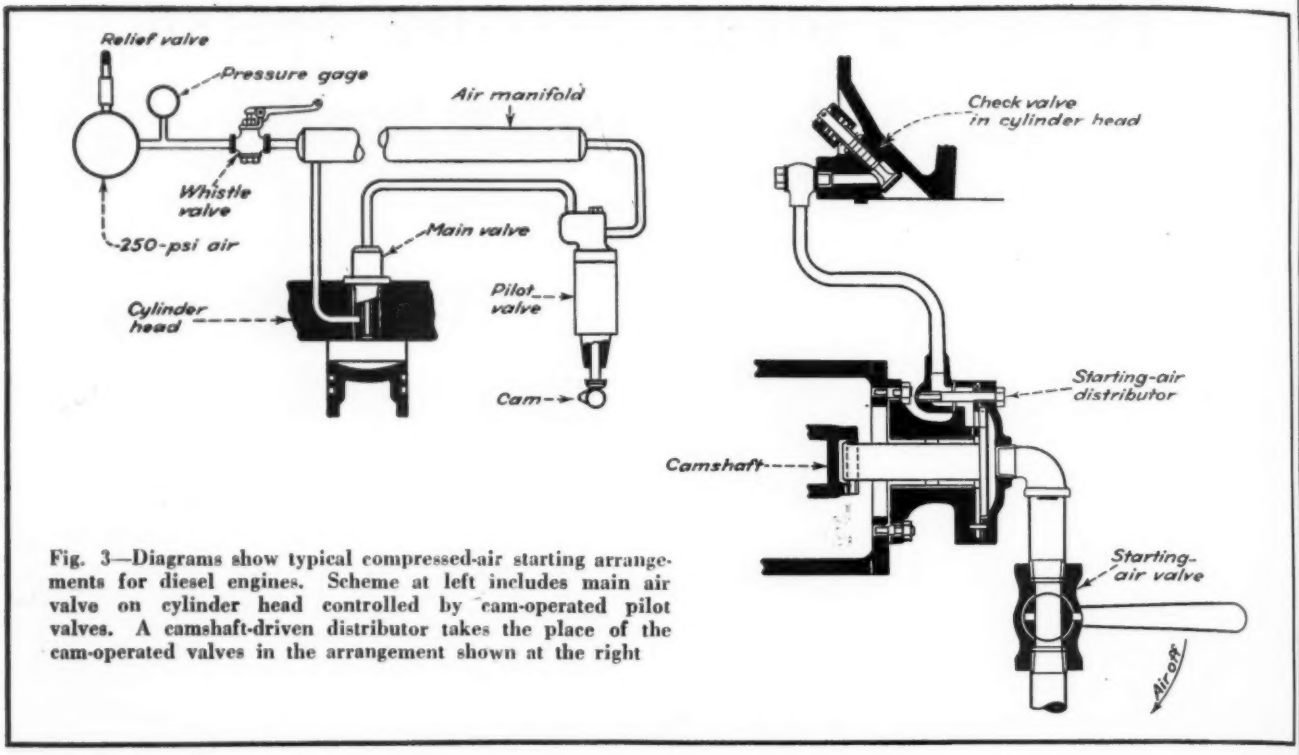

Fig. 3—Diagrams show typical compressed-air starting arrangements for diesel engines. Scheme at left includes main air valve on cylinder head controlled by cam-operated pilot valves. A camshaft-driven distributor takes the place of the cam-operated valves in the arrangement shown at the right

air to the distributor to begin the starting operation and cuts it off when the engine starts to fire.

So much for the air-starting equipment on the engine. A complete system requires one or more tanks for storing air under pressure, compressor equipment to charge them, and the necessary piping, valves, etc. For a single-engine plant, two tanks represent good practice; for multi-engine plants, one tank for each engine. A rule of thumb sets tank capacity at about 30 times the displacement of a single engine cylinder. Usually the engine builder specifies the receiver capacity and often supplies the tanks. Because of the hazard involved, starting tanks should be built for 25–50% in excess of the working pressure and according to the rules of the ASME Code for Unfired Pressure Vessels.

Starting Compressor Size

Starting-air-compressor size depends on how fast the air tanks are to be charged. The amount of air drawn from the receiver for a single start may be assumed (about 5–10% of receiver volume) or it may be calculated from the amount going to each cylinder per "shot," the number of cylinders getting air, and the estimated number of shots required for an average start. Compressor size may then be found by dividing the amount of air to be put back into the tank by the time allowed for recharging. This must be fast enough to insure reliable operation, yet not so fast as to involve a compressor of excessive size. For the average plant, where engines start infrequently, 10–20 min might be reasonable.

If a single compressor is installed, a gasoline-engine drive insures ability to start the plant from a complete shutdown. A common arrangement involves a single compressor with both gasoline-engine and motor drive. If there are several compressors, at least one should be gasoline-engine driven. A simple pressure-switch hookup permits automatic tank recharging from the motor-driven unit or units.

Piping for the compressed-air circuit follows standard practice, with special attention to provision of ample drains and necessary safety and relief valves. Unions at strategic places permit convenient dismantling for inspection or repair. Fig. 4 shows a typical hookup, with two compressors and a number of receivers; for simplicity, only one engine is shown.

Particular attention should be given

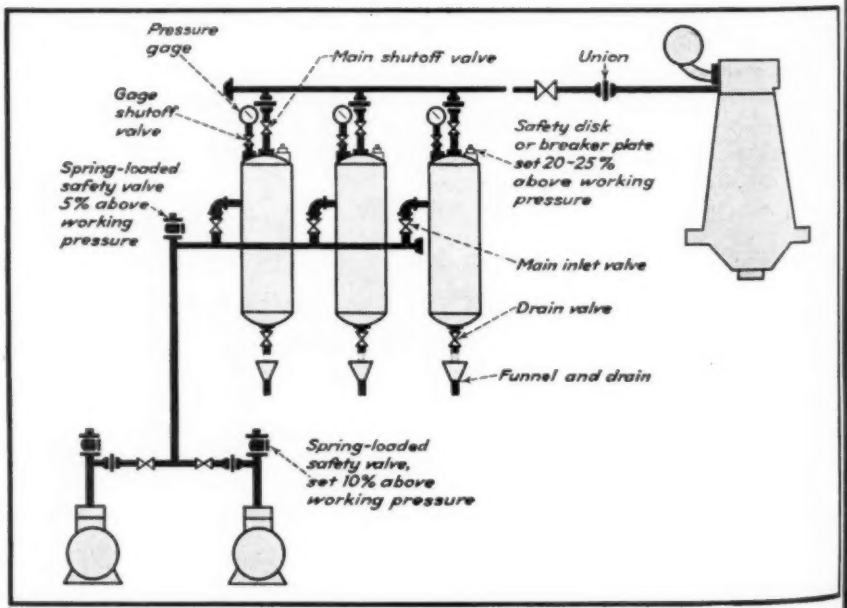
Pressure gage
Main shutoff valve
Union
Gage shutoff valve
Safety disk or breaker plate set 20-25% above working pressure
Spring-loaded safety valve 5% above working pressure
Main inlet valve
Drain valve
Funnel and drain
Spring-loaded safety valve, set 10% above working pressure

Fig. 4—Typical piping layout for an air-starting system with two compressors. Note safety and relief valves, provision for drainage, and unions for dismantling

to sizing and location of safety valves. Capacity of storage tanks does not determine valve size; it depends on compressor output. The ASME Code for Unfired Pressure Vessels specifies that safety valves for air shall be of the direct spring-loaded type; if more than one valve is used, discharge capacity is taken as combined capacity of all valves. There should be no stop valve between safety and compressor.

Compressed-air starting finds wide application on medium and large size engines in stationary and marine applications. Smaller engines, particularly units in transportation and portable applications, require more compact and simpler starting equipment. Various power- and hand-cranking arrangements solve this problem.

Battery-operated electric-motor starting, as in the automobile, fits a wide variety of conditions. High compression makes the diesel hard to start; 24- and 32-volt motors supply the needed high starting torque without excessive starting current. Batteries must be specially designed to deliver large amounts of electrical energy during the starting period. Generator-voltage control regulates rate of battery charge.

When diesels drive generators, a starting motor may not be necessary. On diesel-electric locomotives, for example, the batteries supply energy to permit the generators to serve as starting motors. Generators may be used thus in diesel-electric power plants interconnected with a power system that supplies the necessary energy. This requirement limits application of the scheme.

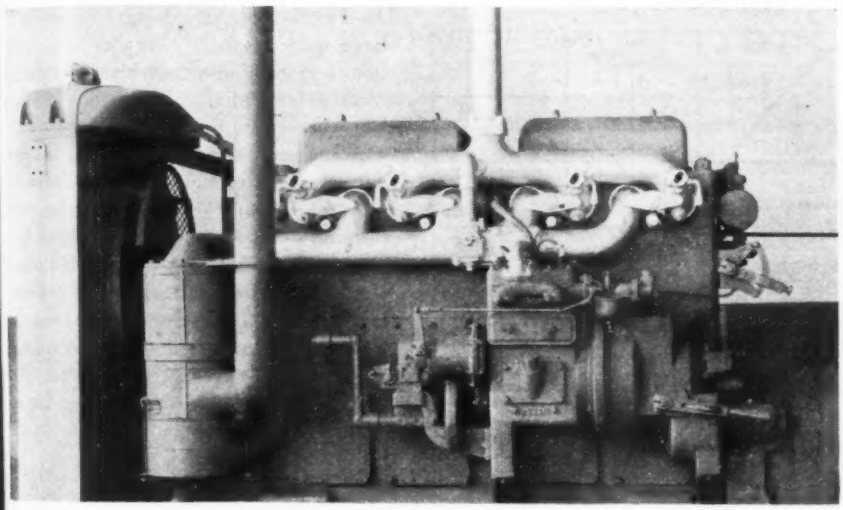

Fig. 5—Auxiliary gasoline engine mounted on main unit, provides cranking power. Started by hand cranking, it drives diesel through gearing, clutch and Bendix

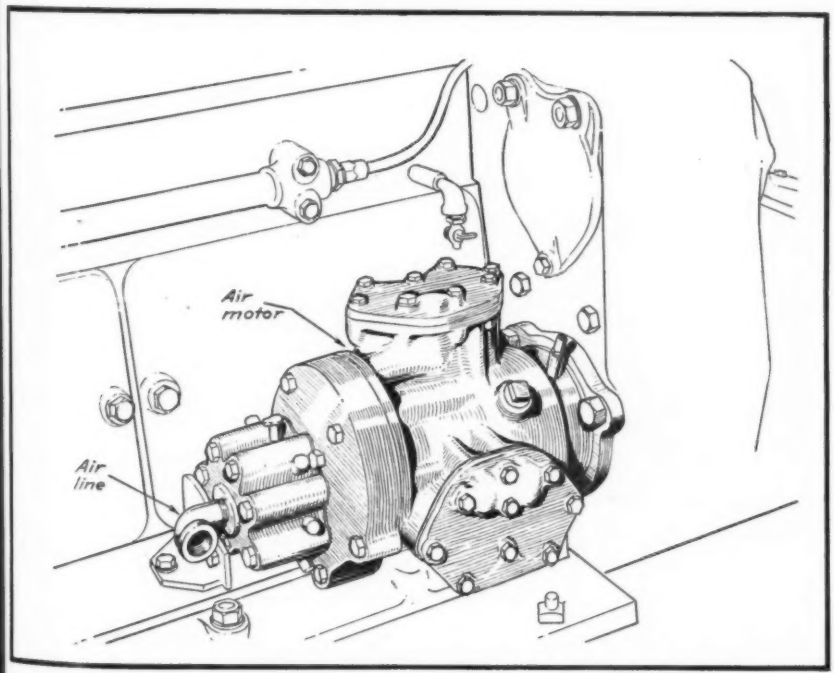

Fig. 6—Recently introduced air motor, driving main unit through a Bendix engaging the flywheel, operates satisfactorily on air pressures from 100 to 250 psi

To start the main engine, some engine builders provide an auxiliary gasoline engine, which may be hand cranked. Fig. 5 shows such an auxiliary, mounted on the side of the main engine. The gasoline unit, either 2- or 4-cylinder, drives through gearing, a clutch and a Bendix. Hot water from the gasoline-engine jackets circulates through the diesel water spaces to speed the warm-up. A major advantage of this method is that once started the gasoline engine runs until the main engine starts, even under cold weather or other adverse conditions. Auxiliary-engine starting finds use on large mobile equipment and on some railway installations.

The recently introduced air motor represents still another source of cranking power. Fig. 6 shows such a unit, consisting of two small 2-cylinder engines, 90 deg apart, on a common crankshaft. Engines operate on the 2-cycle principle; air exhausts part way down on the power stroke, with line pressure relieved during part of the upstroke. A rotary air valve, at left of unit in Fig. 6, times air admission to the cylinders. The motor drives through a Bendix geared to the flywheel. Designed to operate at pressures up to 250 psi, the motor runs satisfactorily at pressures as low as 100 psi. This permits connection to most standard compressed-air systems, a particular advantage in industrial plants and on shipboard where air systems are customarily installed for other purposes.

Methods of Hand Cranking

Only the smallest diesels can be manually cranked and then only with the aid of a decompression device and a fairly heavy flywheel to maintain speed after compression has been restored. To make starting of larger units by hand cranking possible, one builder arranges the engine to start as a gasoline engine. Opening a valve connects an auxiliary chamber with the working cylinder, lowering the compression. The same operation switches on high-tension ignition to a spark plug in the auxiliary chamber, shunts normal air supply through a starting carburetor, and opens a fuel-shutoff valve in the carburetor. The operator hand cranks the engine, which starts easily as a gasoline engine. After a short running period, he trips the starting lever and the now warmed-up engine swings over to diesel operation.

A Short Cut to Turbine Cycle Heat Rates—2

► IN THE FIRST PART of this article, October POWER, calculations of the values t and U were detailed. Several interesting results are available from the data thus far presented. Among the more important is the ability to predict total quantity of steam extracted from the turbine as a percent of the throttle flow. We have previously deduced that the amount of steam extracted determines the gain in heat rate over the non-extraction heat rate. Conversely, knowing the gain in heat rate, we are able to find the total quantity of extraction. If it is expressed as a fraction of the throttle flow, the formula that applies is:

$$(3)\quad \frac{w}{1+w} = \frac{\text{Lb per hr extracted}}{\text{Lb per hr throttle flow}} = \frac{R+\left[\frac{PG'}{1-PG'}(H_e-h)\frac{U}{t}\right]}{U+t}$$

where:

w = Total lb extracted per lb of condenser flow
R = Rise in feedwater enthalpy effected by extraction feedwater heating, Btu per lb
H_e = Initial heat content at throttle, Btu per lb
h = Final feedwater temperature at exit of top heater, Btu per lb
U = Internal used energy of the turbine (with no exhaust loss), Btu per lb
t = $H_e - h_e$

In this formula PG' designates the usual value of PG from Fig. 2 and 3 (October POWER) corrected to include the proper allowance for terminal difference and pressure drop, flash losses, etc. The normal allowance is about 0.5 to 1% in *extraction* heat rate, which means 0.5 to 1.0 × (1−PG) points in PG. If C is the percent loss in extraction heat rate due to cycle deviations from the theoretical cycle having zero pressure drop and zero terminal difference, then $PG' = PG - C(1 - PG)$. The extraction quantities found by formula (3) are strictly accurate provided only that C is known accurately. As a matter of fact, normal values of C have only a small effect on the fractional extraction as is clearly evident from a few calculations using formula (3) (see example 5 on page 80).

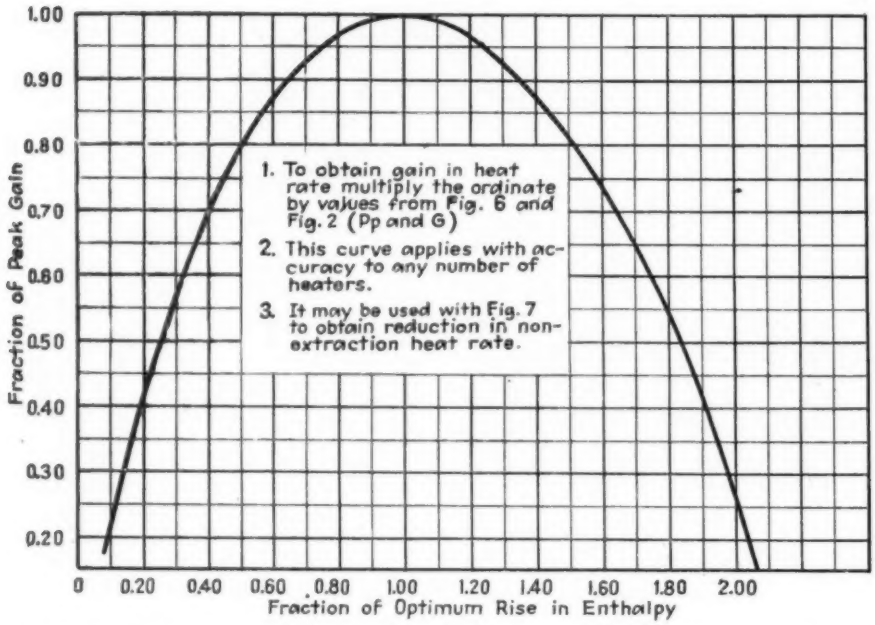

Fig. 5—Loss due to variation from optimum feedwater enthalpy. This curve results from coordination of the shapes of the curves of Fig. 3 (October POWER)

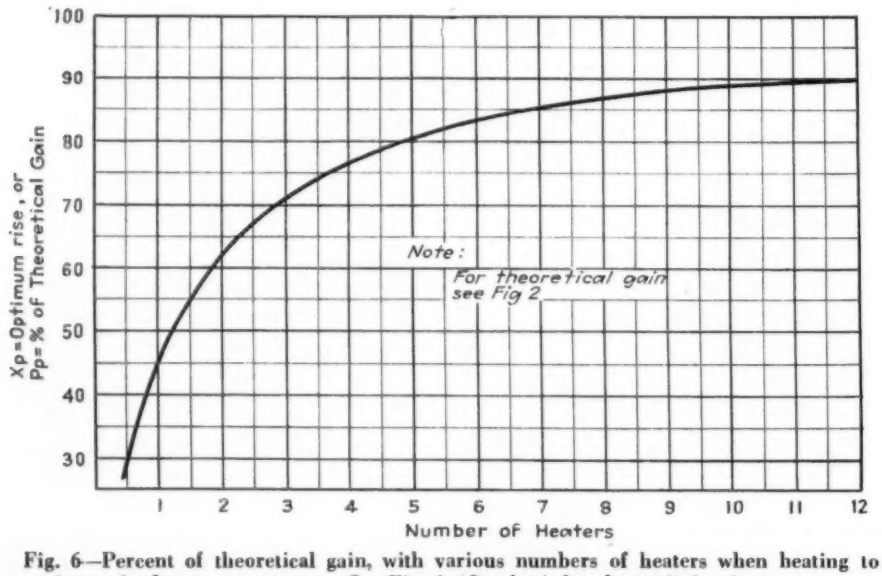

Fig. 6—Percent of theoretical gain, with various numbers of heaters when heating to optimum feedwater temperature. See Fig. 2 (October) for theoretical gain

Another important derivation of the data herein provided is the loss in internal output* resulting from extraction for feedwater heating. This loss in output results from the extraction of steam at points intermediate between the throttle and exhaust, the quantity extracted thereby being prevented from doing its full quota of work. The value of PG' uniquely determines the loss in output, which may be found from the following formula:

$$(4)\quad \frac{\text{Extraction internal output}}{\text{Non-extraction internal output}} = \frac{1-\frac{R}{U+t}}{1-PG'}$$

As in formula (3), the value of PG' is the true gain over the non-extraction heat rate, including the proper allowance for cycle deviations from the theoretical. If the output ratio at the generator terminals is required, it may be found by increasing the above output ratio to take account of the gain in output due to reduced exhaust loss (1 to 2.5%) and the change in mechanical and electrical efficiency (determined from data supplied by the manufacturer on generator and fixed losses). In fact, the correction to the uncorrected heat rate for change in turbine efficiency, previously discussed, results from the change in exhaust loss, which increases the load for the same throttle flow, and as a result decreases the heat rate in inverse proportion. In this sense the exhaust loss acts exactly as a purely external loss, such as generator loss.

From Fig. 3 and 4 it is evident that there is a best, or optimum, feedwater temperature for any given steam conditions and number of heaters. It is

*Internal output is the *turbine* output which would be obtained if the exhaust loss and mechanical losses were zero.

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Further charts and methods, including computation of numerical examples, for quick estimation of gain due to feedwater heating

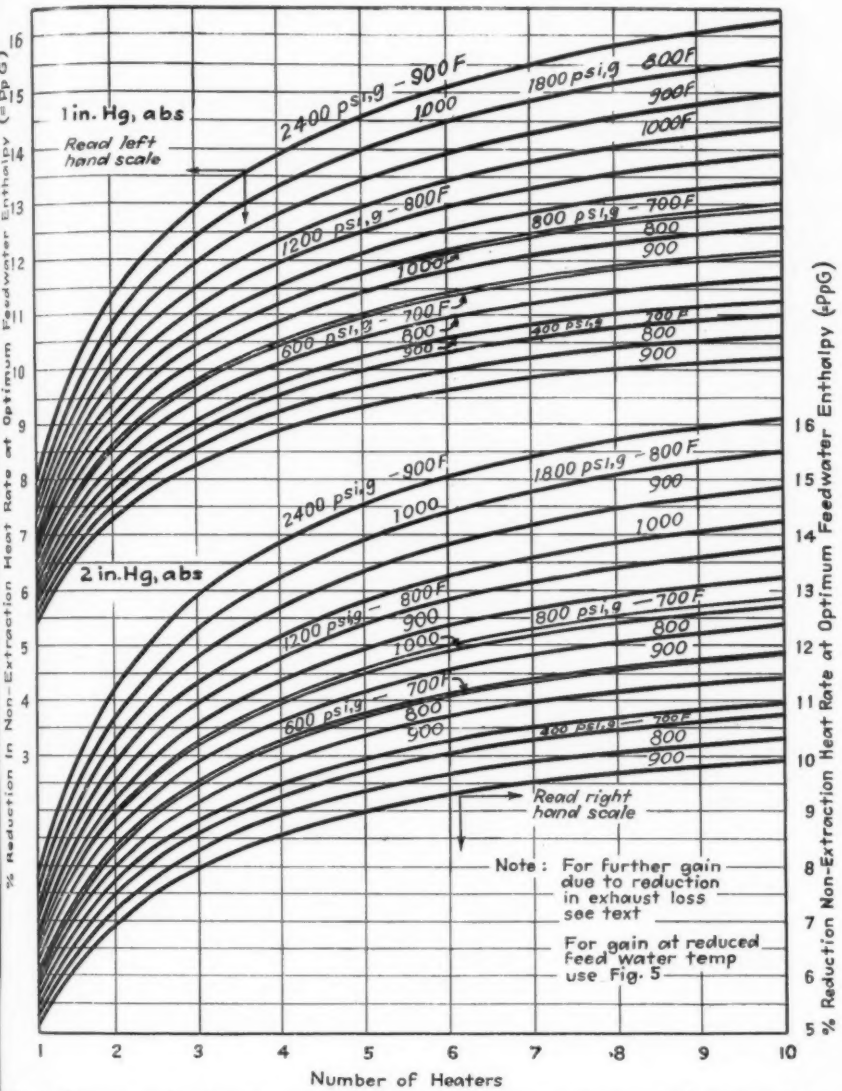


Fig. 7—Percent reduction in non-extraction heat rate at optimum feedwater enthalpy (derived curves) for various steam conditions and condenser pressures

however, frequently the case that the final feedwater temperature in an extraction cycle is not the optimum, that is, the one which gives best performance. It would be interesting, therefore, to have an integrated representation of the loss incurred by variation of the actual from the best feedwater temperature. Fig. 5 illustrates the variation of the gain in heat rate over non-extraction heat rate as the temperature rise in the feedwater heating system varies from the optimum rise (designated by 100% in the abscissa) to lower or higher values. This single curve, which is a correlation of the curves shown in Fig. 3, was constructed by calling the peak value of P 100% and the rise at which it occurs 100% (of the optimum rise). A plot of the various curves in Fig. 3 using these relative coordinates yields curves that are practically coincident—so closely coincident that they may be considered as a single curve.

If we knew both the optimum rise in feedwater enthalpy and the actual gain in percent of the non-extraction heat rate (P_pG) at the peak of the curves in Fig. 3, then by entering Fig. 5 at any fraction of the optimum rise we could read the fraction of the peak gain (P_pG), realizable at the given fraction of the optimum rise, and by multiplication obtain the true gain at this rise. Furthermore, the loss due to departure from the optimum rise is directly available, by subtraction from P_pG. Fig. 6 is a plot against number of heaters of the values of P at the peaks of the curves in Fig. 3. By inspecting the latter, it is apparent that the peak values of P are numerically equal to the fractional rises at which these peak values occur. Fig. 6 may, therefore, be used to determine either the fraction of the rise at which maximum gain occurs, or the fraction of the theoretical gain obtained at this fractional rise. To obtain the true gain, P_pG, at the peak of the curves in Fig. 3, calculations were made for various steam conditions and plotted in Fig. 7. These curves graphically present against number of heaters the uncorrected gain, P_pG, for most commonly used steam conditions at two different back pressures. Linear interpolation may be used for pressure, temperature and exhaust pressure. The values found from these curves are uncorrected for cycle (0.5 to 1% in heat rate) and change in turbine efficiency (1 to 2.5%). The curves are extremely convenient in that we may read directly, without any calculations whatsoever, the gain obtainable by heating the feedwater to the best temperature.

Using Fig. 7, we can obtain the gain at the optimum feedwater temperature, that is, at the fraction of the possible rise in Fig. 6. If the actual rise is less than this, then from Fig. 5 we may read a multiplying factor to be applied to this gain, yielding the uncorrected gain at the actual rise.

Advantages of Method

The advantages of such simple representation are many. In graphical form are shown all the important variables. The engineer's mind in general reacts to curves of data more readily than to a series of isolated numerical results obtained by laborious calculation and subject to the errors inherent in such long and tedious calculations. These curves and tables accomplish several important results:

1. They show that there is a definitely fixed optimum feedwater temperature and enthalpy rise for each set of steam conditions and number of heaters (Fig. 3 and 4).

2. They indicate immediately and graphically the change in heat rate due to changing number of heaters (Fig. 7).

3. They show graphically the effect of a higher or lower feedwater temperature (Fig. 5).

4. They show that the gain in heat rate at higher pressures is a result not only of the improvement in the non-extraction heat rate but also of the

greater gain due to feedwater heating (Table 1 [October POWER] and Fig. 7).

5. They indicate that increase in temperature at a given pressure has two opposing effects: The non-extraction cycle efficiency improves but the possible gain resulting from feedwater heating decreases, still giving, however, a net gain (see Table 1 and Fig. 7).

6. They illustrate clearly the decreasing value of each successive heater added to a cycle (Fig. 6).

Examples of Method

Only complete familiarity with the factors presented herein enables the user to perform the many possible operations. To facilitate an understanding of the elementary methods of using the curves, nine examples are given herewith, covering the following problems, to: (1) find the value of additional heaters, (2) find the optimum feedwater temperature, (3) find the loss due to "underheating," (4) find the state-line end point, given necessary data, (5) find the condenser flow for a given cycle, (6) find the condenser duty, (7) find the extraction throttle steam rate, (8) find the heat rate, (9) compare two plants having different steam conditions with: (a) constant turbine efficiency, (b) actual turbine-generator efficiencies as they vary in practice, and (c) actual turbine-generator efficiencies, including the difference in feed-pump power.

1. What is the gain in heat rate due to using five heaters instead of four at 425-F feedwater temperature? At 350-F feedwater temperature?

Steam conditions: 800 psi, g, 850 F, 1 Hg.
$h_{sat} = 512.3$ $h_s - h_e = 465.2$ (= possible rise)
$h_{425} = 402.3$ $h_{425} - h_e = 355.2$ $\therefore$ % of possible rise = 76.4
$h_{350} = 321.6$ $h_{350} - h_e = 274.5$ $\therefore$ % of possible rise = 59.0
Optimum rise (Fig. 6) = 76.5% (of possible rise) for 4 heaters
= 80.0% (of possible rise) for 5 heaters

	425 F		350F	
Rise — % of optimum...	4 heaters	5 heaters	4 heaters	5 heaters
	76.4	76.4	59.0	59.0
	——=99.9	——=95.5	——=77.1	——=73.7
	76.5	80.0	76.5	80.0
The % of gain at optimum feedwater temperature (Fig. 5).....	100	100	96.0	94.5
Gain at optimum feedwater temperature (Fig. 7), P_sG.....	10.65	11.19	10.65	11.19
Actual gain.....	10.65	11.19	10.22	10.57

Therefore at 425-F feedwater temperature the five-heater cycle is 0.54% in *non-extraction* heat rate better than the four-heater cycle, or there is an improvement due to five heaters of $\frac{0.54}{1-0.1065} = 0.60\%$, in actual heat rate.

At 350-F feedwater temperature the five-heater cycle is 0.35% in *non-extraction* heat rate better than the four-heater cycle, or there is an improvement due to the five heaters of $\frac{0.35}{1-0.1022} = 0.39\%$, in actual heat rate.

(These values neglect a small additional gain due to the slightly lower exhaust loss when using five heaters, but this is negligible.)

2. What is the optimum feedwater temperature for three heaters at the above conditions?

Optimum rise is 70.8% of the "possible rise" (from Fig. 6)
Possible rise = 465.2 Btu per lb.

$$0.708 \times 465.2 = 329.4$$
$$h_e = 47.1$$
$$h = 376.5$$

From steam tables at 376.5 Btu, the optimum temperature is 401.4F, which checks Fig. 4.

3. What is the loss in the four-heater cycle of example 1 if we use 350-F feedwater temperature instead of the optimum feedwater temperature?

Gain at optimum rise, $P_sG = 10.65\%$ (Fig. 7)
Realizable fraction at 350-F = 96.0 (Fig. 5)
Loss in % of non-extraction heat rate = 10.65 (1–0.96) = 0.43%
Loss in % of extraction heat rate $= \frac{0.43}{1-.1065} = 0.48\%$ (increase in heat rate)

4. What is the state-line end point of a unit for which the following data is known?

35,000-kw unit: steam conditions: 800 psi, g, 850F, 1 in. Hg
Non-extraction steam rate at 35,000 kw = 7.55 lb per kwhr
Unit is 3600 rpm, hydrogen cooled, and has a last stage annulus area of 41.7 sq ft

Theoretical steam rate* = 6.120

$$AE = \frac{3412.75}{6.120} = 557.6 \text{ Btu per lb}$$

Throttle flow = 35,000 × 7.55 = 264,250 lb per hr
Estimated exhaust moisture = 11.9%
$\therefore$ exhaust specific volume = 652.3 (1–0.119) = 575
Annulus velocity $= \frac{264,250 \times 575}{3600 \times 41.7} = 1012$ fps
From Fig. 10 of reference(**) the exhaust loss is 26.5 Btu
The % exhaust loss is, therefore, $\frac{26.5}{557.6} = 4.75\%$
From Fig. 8 of reference(**) the generator efficiency is 98.4%, or the losses are 569 kw
From Fig. 9 of reference(**) the mechanical losses are 295 kw
Total losses are 864 kw, and the mechanical and electrical efficiency is:

$$1 - \frac{864}{35864} = 97.59\%$$

From formulas (1) and (2) October POWER

$$U = \frac{3412.75}{7.55 \times .9759 \times (1-0.0475)} = 486.3 \text{ Btu per lb}$$

$H_e = 1426.6 - 486.3 = 940.3$ = state-line end point
Moisture = 14.8% (instead of the previously estimated 11.9%)
Recalculating the exhaust loss using this new value of the moisture, we get 25.5 Btu at an annulus velocity of 978 fps., or 4.57% *EL*. Substitution in the formula for U, a second approximation to U of 485.4 is obtained, which is sufficiently accurate without further trials.
The state-line end point, H_e, then is
$H_e = 1426.6 - 485.4 = 941.2$ Btu per lb

5. What is the condenser flow for the previous example when five heaters are used to heat to the optimum feedwater temperature?

$P_sG = 11.19\%$ $U = 485.4$ $H_e = 941.2$
$l = (941.2 - 47.1) = 894.1$
Possible rise = 512.3 – 47.1 = 465.2

*"*Theoretical Steam Rate Tables* by J H Keenan and F G Keyes, ASME, New York, N. Y., 1938.

**"Relative 'Engine Efficiencies' Realizable for Large Modern Steam-Turbine Generator Units" by G B Warren and P H Knowlton, *ASME Transactions*, Feb. 1941.

Optimum rise = $0.800 \times 465.2 = 372.2$ Btu

$h = 372.2 + 47.1 = 419.3$ = enthalpy of feedwater

Allow 1% for cycle losses, which gives a corrected value of PG:

$PG' = 11.19 - 1.0\ (1 - 0.1119) = 10.30\%$

Then, using formula (3):

$$\frac{w}{1+w} = \frac{372.2 + \left(\frac{10.30}{89.70}\ (1426.6 - 419.3)\ \frac{485.4}{894.1}\right)}{1379.5}$$

$= 0.3153$ or 31.53% of the throttle flow

(Note that if the cycle correction is zero, the extraction is 31.97%.)

Condenser flow is $264{,}250\ (1 - 0.3153) = 180{,}932$ lb per hr

6. What is the condenser duty in the above example?

The exhaust annulus velocity for extraction operation will be $978\ (1 - 0.3153) = 670$ fps

From the exhaust loss curve of reference (**) the exhaust loss is 13.0 Btu per lb of condenser flow

Internal efficiency is $\frac{485.4}{557.6} = 87\%$ (unchanged, even though steam is being extracted)

Exhaust heat content, including exhaust loss, then, is:

$$941.2 + (0.87 \times 13.0) = 952.5$$

Condenser duty = $180{,}932\ (952.5 - 47.1) = 163{,}816{,}000$ Btu per hr

7. What is the extraction throttle steam rate?

From formula (4)

$$\frac{\text{Extraction internal output}}{\text{Non-extraction internal output}} = \frac{1 - \frac{372.2}{1379.5}}{1 - 0.1030} = 0.8139$$

From example 6 the exhaust loss is 13 Btu per lb when operating with extraction, hence the kw exhaust loss is

$$\frac{180{,}932 \times 13 \times 0.87}{3413} = 600 \text{ kw}$$

and the bleeding net output of the turbine unit, assuming no electrical or mechanical losses, is:

$$0.8139 \left(\frac{35{,}000}{(1 - .0457)\ .9759}\right) - 600 = 29{,}988 \text{ kw}$$

The generator and fixed losses for this load are found (**) to be 843 kw, hence the net load is 29,145 kw and the extraction throttle steam rate is:

$$\frac{264{,}250}{29{,}145} = 9.067 \text{ lb per kwhr}$$

8. What is the heat rate of the cycle?

Method A: Over-all efficiency = $\frac{6.120}{7.55} = 81.06\%$

Non-extraction theoretical heat rate = 8443 Btu per kwhr

Non-extraction heat rate = $\frac{8443}{0.8106} = 10{,}415.7$ Btu per kwhr

(also: $7.55 \times (1426.6 - 47.1) = 10{,}415.2$)

$P_sG = 11.19\%$ and allowing 1% in heat rate for cycle losses corrected $P_sG = 11.19 - 1\ (1 - .1119) = 10.30\% = PG'$

Since the exhaust flow is $\frac{264{,}250}{41.7} = 6340$ lb per hr per sq ft

it would appear from the text of Part 1 (October POWER) that we ought to allow about 2½% for improved turbine efficiency. The heat rate, then is:

$10416\ (1 - 0.1030)\ 0.975 = 9110$ Btu per kwhr

and the throttle steam rate is:

$$\frac{9110}{1426.6 - 419.3} = 9.044 \text{ lb per kwhr}$$

hence the load is:

$$\frac{264{,}250}{9.044} = 29{,}218 \text{ kw}$$

(The failure to obtain an exact check results from the slight error in the assumption of the gain due to exhaust loss.)

Method B: Using the data of Examples 5 and 7, the heat rate may be found directly:

$9.067\ (1426.6 - 419.3) = 9133$ Btu per kwhr

9. What is the approximate difference in heat rate of two 40,000-kw turbine cycles, using 3600 rpm units?

(A) 1200 psi, g, 900-F, 1 in., 5 heaters (optimum rise)

(B) 800 " 850-F, 1 " 5 heaters (" ")

(a) with constant over-all efficiency, (b) with the actual efficiencies, (c) including difference in boiler-feed pump power as well as difference in turbine-generator efficiency.

(a) Assume the turbine-generator efficiencies both to be 80%

1200-psi plant: $\frac{3090}{0.80}\ (1 - 0.121)\ 0.975 = 8667$ Btu per kwhr

800-psi plant: $\frac{3413}{0.80}\ (1 - 0.112)\ 0.975 = 9137$ Btu per kwhr

Thus the 1200-psi plant is better by 5.14%, neglecting difference in turbine efficiency and boiler-feed-pump power.

(b) From Fig. 5 of reference (**) the relative efficiencies of the turbine-generators may be found:

At 300-F superheat the over-all efficiency of the 1200-psi machine is..... 77.2%

At 300-F superheat the over-all efficiency of the 800-psi machine is..... 78.4%

The superheat actually is about 330F in each case, hence from Fig. 6 of reference (**), these efficiencies are both actually 0.5% better, or 77.59% and 78.79%, respectively.

The 1200-psi machine efficiency is:

$\frac{1.20}{78.79} = 1.52\%$ poorer than the 800-psi machine

hence the 1200-psi plant is better by only:

$$1 - \frac{1 - 0.0514}{1 - 0.0152} = 3.68\% \text{ when}$$

turbine efficiency is taken into account (still neglecting the effect of boiler-feed-pump power on the comparative heat rates.) This difference assumes equal exhaust losses on the two machines.

(c) The approximate throttle flows for the two machines may be found, as in the previous examples, to be:

for the 1200-psi machine = 372,000 lb per hr
for the 800-psi machine = 372,400 lb per hr
} at 40,000 kw

The enthalpy rise across the pump, assuming 70% efficiency, is, from the steam tables:

$\frac{3.2}{0.7} = 4.57$ Btu for the 1200-psi plant

$\frac{2.1}{0.7} = 3.00$ Btu for the 800-psi plant

These values allow 25% excess pumping head for friction, etc. Assuming the pump handles the full throttle flow, the pump input, expressed in kw, is:

1200-psi: $\frac{372{,}000}{3413} \times 4.57 = 498$ kw = 1.25% of main generator output

800-psi: $\frac{372{,}400}{3413} \times 3.00 = 327$ kw = 0.82% of main generator output

The input to the boiler-feed pump is returned to the feedwater as heat and thus recovered at the cycle efficiencies which average about 37%. Hence the net difference in feed-pump power is:

$(1.25 - 0.82)\ (1 - 0.37) = 0.27\%$ in favor of the 800-psi plant

The true comparison, therefore, is for equal exhaust loss:

$3.68\% - 0.27 = 3.41\%$ in favor of the 1200-psi plant.

In a specific case the choice of exhaust sizes may slightly raise or lower this figure.

Carbon Dioxide Guards Critical Generators

And stands ready to snuff out fire before the rotor fans it into a flaming mass of melted copper and iron. P W Eberhardt, Walter Kidde & Co, describes an installation and explains how the discharge can be controlled

▶ THE PHELPS-DODGE MINE and reduction-works power plant at Morenci, Arizona, furnishes power for such miscellaneous services as haulage locomotives, crushing plant, concentrator, smelter, repair shops and town site. The development is the largest complete, coordinated works of the sort to be planned and built from scratch. Bigger ones exist, but they represent a series of gradual extensions and additions to the original layout.

Plant generates power with three General Electric and one Westinghouse 15,000-kw turbogenerators. Original plans called for three units with space provided for another, but war-production demands required installing the fourth unit years ahead of time. Lack of an outside power source and material shortage increased the desirability of protecting these critical machines against damage, so naturally plant design incorporated an adequate fire-fighting system.

One important point to consider in fighting fire is the time element. Engineers have found that gas-discharge rate is the critical factor in efficient and effective extinguishment. The system furnished by Walter Kidde & Co, therefore, was designed to deliver directly to the danger point sufficient carbon dioxide to snuff out flame almost instantaneously. This stops further propagation. Additional gas injected during shutdown compensates for leakage as the incandescent glow cools.

Deceleration Period

Morenci generators have a deceleration period of 25 min without application of the field. This means that at least a 25% carbon-dioxide concentration, sufficient to reduce the oxygen content of the air below the combustion point, must be maintained for approximately half an hour. A dual discharge system fed from either a main or reserve bank, each made up of twelve 50-lb cylinders of liquefied carbon dioxide, accomplishes this. Reserve bank provides protection when the main one is used.

The 12-cylinder bank is divided into two parts: Four cylinders, manifolded into a common header, discharge through two large orifices, and the remaining eight, similarly manifolded as a separate unit, discharge through a very fine orifice. The valve frame contains four ¾-in. initial and four ½-in. delayed automatic distributing valves in tandem; one of each serves each generator. They discharge simultaneously.

A ¾-in. steel pipe carries initial discharge, and for the delayed system, ½-in. brass pipe is used. The initial-discharge line terminates with two shielded ⅛-in. nozzles, delayed-discharge pipe carries a .0995-in. shielded nozzle—all placed in the intake air duct of each generator close to the rotors so that carbon dioxide reaches the winding without delay. Although all cylin-

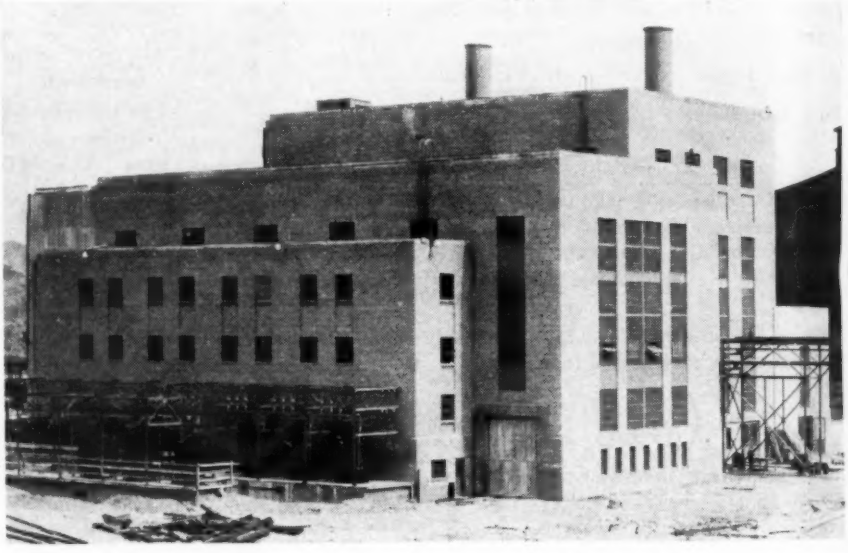


Fig. 1—Smelter furnishes waste heat to generate 40% of reduction-works steam requirements. Two natural gas-fired boilers, with oil standby system, supply remainder

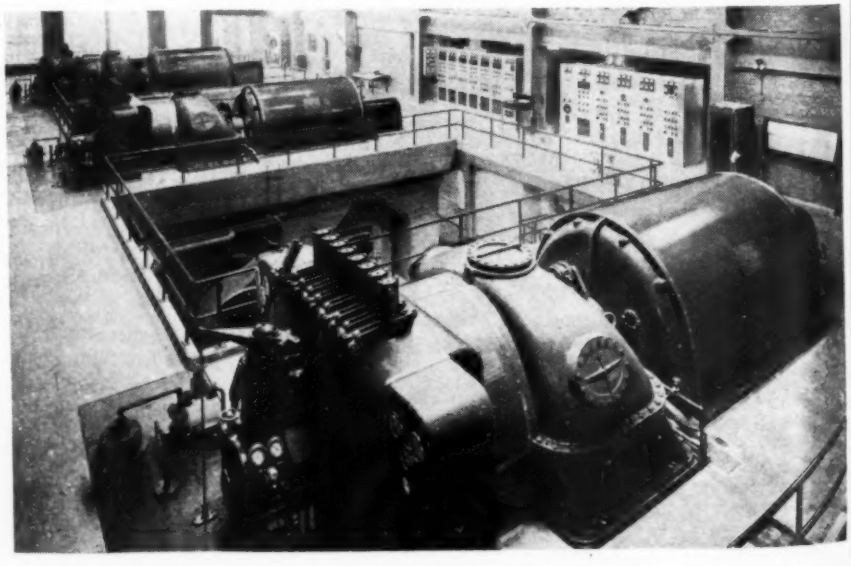


Fig. 2—Power requirements originally estimated at a 2-generator load soon jumped to such proportions that a fourth generator (not shown) was needed to provide spare

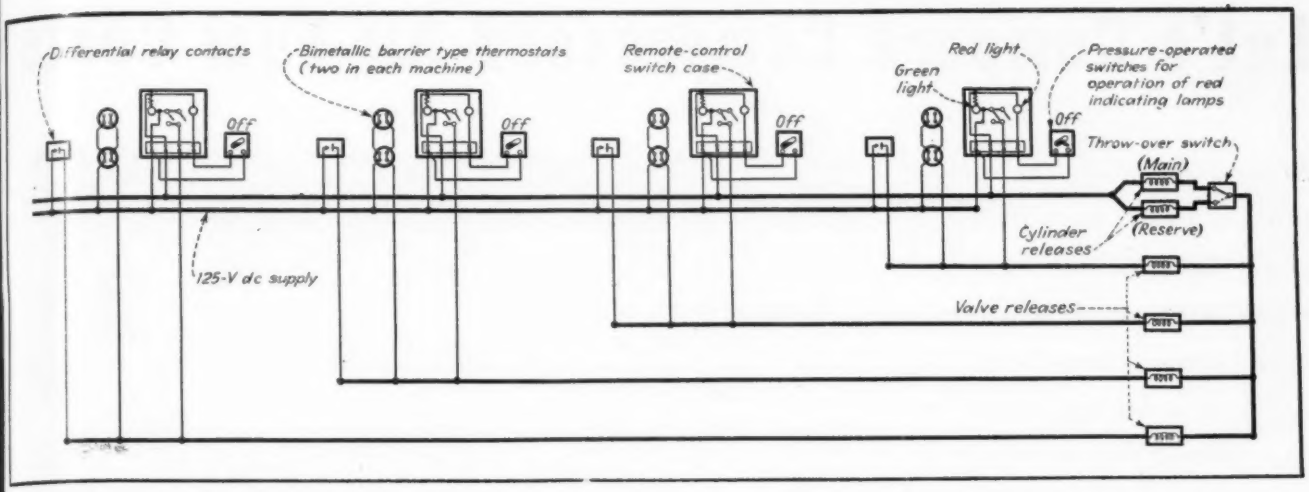


Fig. 4—**Differential relay action, a dependable indication of internal trouble, and temperature thermostats actuate tripping devices automatically. Manually operated switch located at each generator gives an additional tripping station**

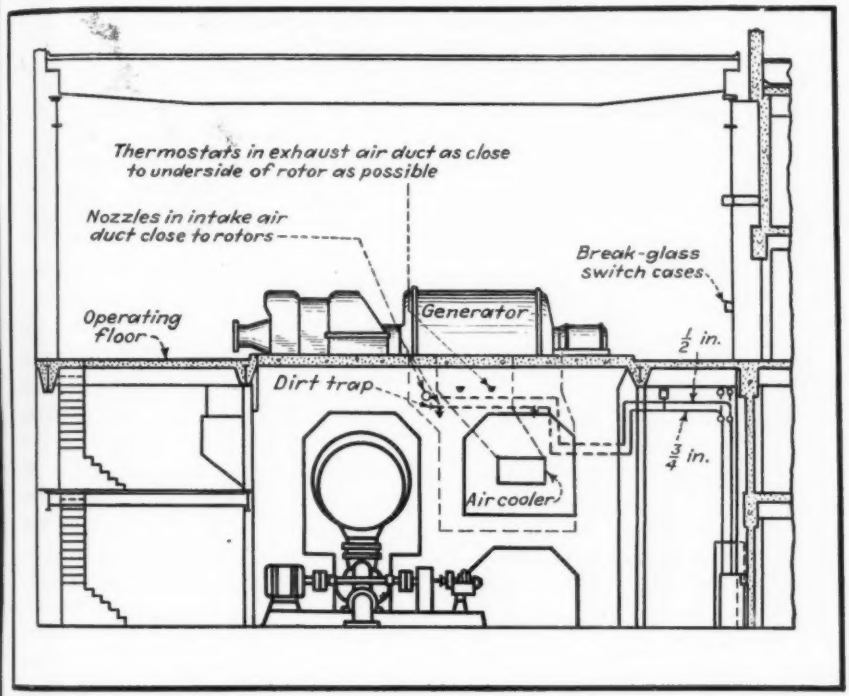


Fig. 3—**Nozzles placed in the generator-air intake discharge the gas in the immediate vicinity of winding. Immediate diffusion starts smothering action on the fire**

ders in one bank discharge simultaneously, smaller nozzle on delayed line lengthens its discharge time to ½ hr.

The system is fully automatic, and can be actuated by any one of the four following methods:

1. *Thermostats in each machine:* Two 212-F single-pole bimetallic thermostats, placed in the exhaust air duct as close to the underside of the rotor as possible, serve each generator. Here they get the down-draft of heated air as it goes to the surface coolers beneath. When this air gets hot enough to actuate the thermostat, it closes an electric circuit to solenoids that open the proper directional valves and release carbon dioxide to that particular generator.

2. *Break-glass control station for each generator:* This provides push-button control so that if a fault occurs, or a bit of smoke appears, or for any other reason fire-prevention measures are necessary, the system can be operated without waiting for the thermostat to reach actuating temperature.

3. *Differential relay tripping:* Reversal of current flow, from a short circuit or ground within the machine, causes the differential relays to function. This operation closes a multi-contact switch that automatically shuts down the generator and energizes the fire-extinguisher system.

4. *Manual operation:* A mechanical release permits operating the system mechanically in the event that no potential is available to energize the automatic features of the electrical circuit. Manual tripping consists of opening valves at the generator afire and at cylinder manifold, and dropping the cylinder valve weights.

Any one of these original operations produces three results: Opening (1) the initial and (2) the delayed discharge valve at the generator involved, and (3) tripping all cylinder releases.

In spite of precautions against possible failure of any one method of initiating the discharge, it is important that the operator be assured that carbon dioxide is actually flowing into the distressed machine. A pressure-operated switch inserted in the initial-discharge line provides this signal; carbon dioxide passing through the pipe to the generator exerts sufficient pressure to operate the switch and close an electrical contact, lighting a red light in the switch case and/or sounding a bell.

A green supervisory light on the other side of the switch box burns continuously as long as electric potential is applied to the electrical circuits of the extinguishing mechanism. (For emergency operation many power stations use batteries.

Finally, a throw-over switch connected in the main control circuit provides for shifting control to the reserve supply of cylinders after the main bank has been discharged. The latter can then be recharged to act as the reserve source of protection.

No generator fire has yet occurred, but engineers responsible for plant operation have the assurance that such an emergency will be met instantly with sure countermeasures, and that their vital war-production plant will not be knocked out by disastrous and costly generator fires.

Let's Compare Compressed-Air Fuel Costs

Before selecting the prime mover, study fuel or power costs* because these expenses reach substantial sums in a year's time. Even though its first cost is higher, the driver that shows lowest fuel cost generally proves to be the most economical investment

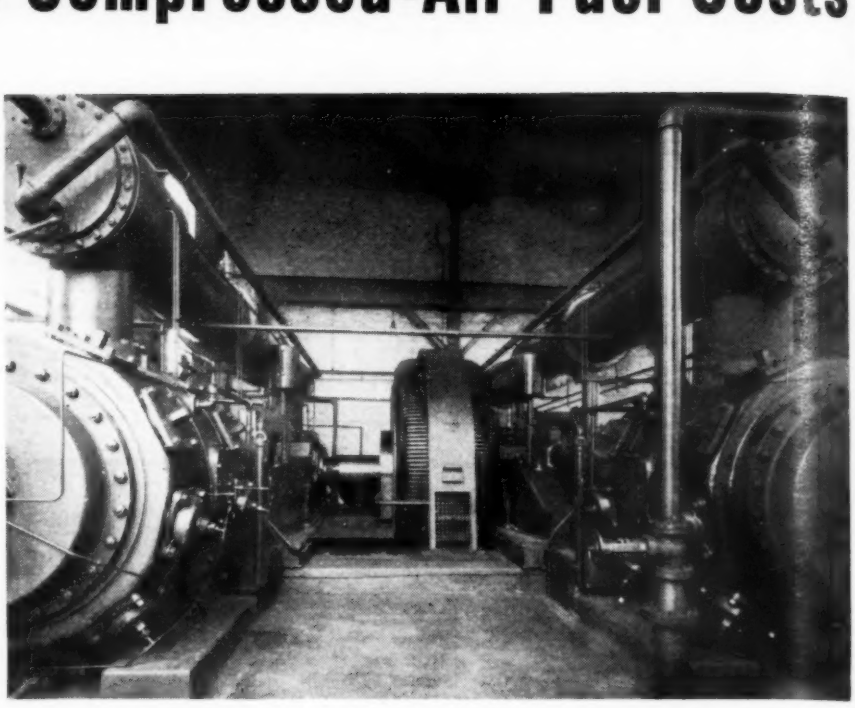


Fig. 1—A plant served with dependable electricity at reasonable rates and requiring no steam for process work usually finds electric-motor drive economical

► CALCULATING THE COST of compressor-system operation begins with initial purchase and installation. This means giving full consideration to power, labor, maintenance and depreciation costs, interest on investment, type of compressor, accessory installation, piping and connections, and distribution-line leakage.

Many factors enter into the selection of a prime mover. One of the first should be fuel cost and availability. In regions of low-cost electric power, an electric drive may be considered favorably. In localities where fuel oil is cheap and readily available, a diesel drive may be best. If low-priced coal is plentiful, surplus steam available, or considerable steam needed for process work, steam may be the economical answer. An abundant, reasonable supply of natural gas indicates a gas engine as prime mover.

When studying the fuel situation, compute the comparative cost of transforming energy stored up in these sources into a given quantity of compressed air, say 100 cfm at the required pressure.

Before using Cost Tables 1 to 5, determine from Table 6 bhp required to compress and deliver 100 cfm. Horsepower varies with discharge pressure and altitude. Mechanical and compression efficiencies of the machine also effect power input, but to a smaller degree. Time required to compress this given quantity of air need not be considered when determining cost from the tables, but the figures given must be adjusted to prices prevailing where the plant is located, as follows:

Steam-engine drive. To obtain coal cost, first determine steam consumption and indicated horsepower required to compress 100 cfm at the necessary pressure.

Suppose coal costs $1.00 a ton and each pound evaporates 7 lb of water. Refer to Table I, which gives coal cost based on $1.00 per ton, to compress and deliver 100 cu ft of free air. If the compressor requires 16 hp and uses 24 lb of steam per indicated horsepower, then the figure (column one, line one) is 0.0457 cents.

This gives a basic figure that may be multiplied by the actual coal price and evaporation factor of the particular steam generator. For example: If coal is $4.00 a ton, cost is 4 × 0.0457, or 0.1828 cents. Then, if the boiler evaporates 8 lb of water per lb of coal 7/8 × 0.1828 = 0.1599 cents, cost per 100 cfm of air.

Diesel-engine drive. Assume the compressor is to be driven by a diesel engine requiring approximately the same

* Cost data supplied by Compressed Air Institute

TABLE 1—Coal Cost at One Dollar per Ton to Compress and Deliver 100 Cu Ft of Free Air

Multiply figures by price of coal in dollars per ton; ton = 2000 lb.

Ihp to deliver 100 cu ft free air per min	*Pounds of steam per ihphr required by the engine*									
	24	26	28	30	32	34	36	38	40	42
16	.0457	.0495	.0533	.0572	.0610	.0634	.0680	.0724	.0762	.0800
18	.0514	.0557	.0600	.0643	.0686	.0714	.0772	.0814	.0857	.0900
20	.0570	.0619	.0667	.0714	.0762	.0793	.0857	.0904	.0952	.1000
22	.0627	.0681	.0733	.0785	.0838	.0872	.0943	.0995	.1047	.1100
24	.0684	.0743	.0800	.0857	.0914	.0951	.1029	.1085	.1142	.1200
26	.0741	.0805	.0866	.0929	.0990	.1030	.1114	.1175	.1238	.1300
28	.0798	.0867	.0933	.1000	.1066	.1109	.1200	.1266	.1334	.1400
30	.0855	.0929	.1000	.1071	.1142	.1189	.1285	.1357	.1429	.1500

indicated horsepower. Table 2 gives fuel-oil cost to compress 100 cfm of free air at an oil consumption of one-half pint per bhphr. With oil three cents a gallon and an indicated horsepower of 16, total cost, obtained from the table, is 0.050 cents per 100 cfm.

Gasoline-engine drive. Table 3 gives gasoline cost based on consumption of one pint per bhphr. This amount does not vary greatly, but when there is variation, figures in the table should be changed accordingly. If gasoline costs eight cents a gallon, then (line one, column one) cost is 0.267 cents to deliver 100 cfm of free air at 16 ihp.

Gas-engine drive. Table 4 is based on gas having a heating value of 1000 btu per cu ft. If it has a different heat content, change the figures proportionately. For 16 ihp and gas at ten cents per 1000 cu ft, cost is 0.026 cents.

With internal-combustion engines, give consideration to energy dissipated in the cooling system and through the exhaust and lubricating oil. Some of this otherwise wasted energy may be reclaimed by heat exchangers for certain manufacturing processes or for heating.

Electric-motor drive. In selecting motors, study carefully starting torque, starting current and suitable flywheel effect. The squirrel-cage induction motor usually drives belted or high-speed direct-coupled compressors. But even on these smaller machines the synchronous motor is sometimes used because of its capacity for power-factor correction.

This motor has become standard in sizes ranging from 60 to above 2000 hp. It has high efficiency, especially at partial loads, eliminates belt loss and reduces floor space and maintenance costs.

Consider Efficiency

Cost of electricity in Table 5 is based on 100% motor efficiency. With power at one cent per kwhr and a compressor requiring 16 bhp, cost of delivering 100 cfm of air is 0.200 cents. For example, if the current costs six cents per kwhr, then $6 \times 0.20 = 1.2$ cents to deliver 100 cfm. If the motor operates at 90% efficiency, $1.2 \div .90 = 1.33$ cents per 100 cfm.

In computing energy cost, include factors such as motor efficiency, load factor and the sliding scale of electrical-energy charges. At full load, efficiency of a motor rated at 108 bhp is 91%, and it consumes 88.5 kwhr. At 75% load, with 84 bhp and 90.4% motor efficiency, current consumption is 69.4 kwhr. At one-half load, with

TABLE 2—Fuel-Oil Cost in Cents to Compress 100 Cu Ft of Free Air

Oil consumption one-half pint (about .45 lb.) per bhphr

Bhp to deliver 100 cu ft of free air per min	*Based on fuel oil with effective heat value of 18,500 Btu per lb. Price of fuel oil, cents per gal.*							
	3	4	5	6	7	8	9	10
16	.050	.067	.083	.100	.117	.133	.150	.167
18	.056	.075	.094	.113	.131	.150	.169	.189
20	.063	.083	.104	.125	.146	.167	.188	.210
22	.069	.092	.115	.138	.160	.183	.206	.230
24	.075	.100	.125	.150	.175	.200	.225	.251
26	.081	.109	.136	.163	.190	.217	.244	.272
28	.088	.117	.146	.175	.204	.233	.262	.293
30	.094	.125	.156	.188	.219	.250	.281	.314

TABLE 3—Gasoline Cost in Cents to Compress and Deliver 100 Cu Ft of Free Air

Gasoline consumption one pint (about .75 lb) per bhphr

Bhp to deliver 100 cu ft free air per min	*Price of gasoline, cents per gallon*							
	8	9	10	11	12	13	14	15
16	.267	.300	.333	.367	.400	.433	.467	.500
18	.300	.338	.375	.413	.450	.488	.525	.563
20	.333	.375	.416	.458	.500	.542	.584	.626
22	.367	.413	.458	.504	.550	.596	.642	.688
24	.400	.450	.500	.550	.600	.650	.700	.750
26	.433	.488	.542	.596	.650	.705	.759	.813
28	.467	.525	.584	.642	.700	.759	.816	.875
30	.500	.563	.626	.688	.750	.813	.875	.938

TABLE 4—Gas Cost in Cents to Compress and Deliver 100 Cu Ft of Free Air

Based on fuel consumption of 10,000 Btu per bhphr

Bhp to deliver 100 cu ft of free air per min	*Rate based on 1000 Btu gas. Cost of gas in cents per thousand cu ft*							
	10	15	20	25	30	35	40	45
16	.026	.039	.052	.065	.078	.091	.104	.117
18	.029	.044	.059	.073	.088	.102	.117	.132
20	.033	.049	.065	.081	.098	.114	.130	.146
22	.036	.054	.072	.090	.107	.125	.143	.161
24	.039	.058	.078	.097	.117	.136	.156	.176
26	.042	.063	.085	.106	.127	.148	.169	.190
28	.045	.068	.091	.114	.137	.159	.182	.205
30	.049	.073	.098	.122	.146	.170	.195	.220

TABLE 5—Cost of Electric Current in Cents to Compress and Deliver 100 Cu Ft of Free Air

Based on 100% motor efficiency

Bhp to deliver 100 cu ft free air per min.	*Price of electric current per kwhr-cents*								
	1	1.5	2	2.5	3	3.5	4	4.5	5
16	.2	.3	.4	.5	.6	.7	.8	.9	1.0
18	.225	.337	.45	.562	.675	.787	.9	1.012	1.125
20	.25	.375	.5	.625	.75	.875	1.0	1.125	1.25
22	.275	.412	.55	.687	.825	.962	1.1	1.237	1.375
24	.3	.45	.6	.75	.9	1.05	1.2	1.35	1.5
26	.325	.487	.65	.812	.975	1.137	1.3	1.46	1.625
28	.35	.525	.7	.875	1.05	1.225	1.4	1.575	1.75
30	.375	.562	.75	.937	1.125	1.312	1.5	1.687	1.875

TABLE 6—Approximate Bhp Required by Compressors*

Figures are bhp per 100 cfm of free air actually delivered

Altitude Feet	*Psi Gage: Single Stage*			*Psi Gage: Two Stage*			
	60	80	100	60	80	100	125
0	16.3	19.5	22.1	14.7	17.1	19.1	21.3
1,000	16.1	19.2	21.7	14.5	16.8	18.7	20.9
2,000	15.9	18.9	21.3	14.3	16.5	18 4	20.5
3,000	15.7	18.6	20.9	14.0	16.1	18.0	20.0
4,000	15.4	18.2	20.6	13.8	15.8	17.7	19.6
5,000	15.2	17.9	20.3	13.5	15.5	17.3	19.2
6,000	15.0	17.6	20.0	13.3	15.2	17.0	18.8
7,000	14.7	17.3	19.6	13.0	14.9	16.6	18.4
8,000	14.5	17.1	19.3	12.7	14.6	16.2	18.0
9,000	14.3	16.8	18.9	12.5	14.3	15.9	17.6
10,000	14.1	16.5	18.6	12.3	14.1	15.6	17.2
12,000	13.6	15.9	17.9	11.8	13.5	15.0	16.5
14,000	13.1	15.2	17.2	11.3	12.9	14.3	15.7

*Bhp varies with size and type of compressor

From Compressed Air Data

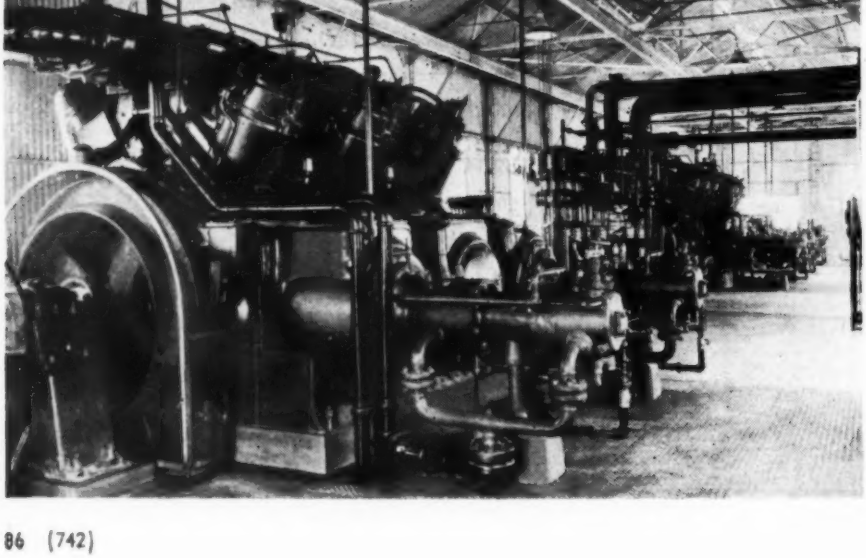


Fig. 2—Investigate internal-combustion drive when rates for the kind of fuel used in these prime movers are low enough to give economical operation

89% efficiency and 60 bhp, electrical consumption is 51 kwhr.

Air leaks in pipelines are an important cost item, but may be effectively reduced through proper maintenance. Leaks in valves and joints individually seem small and insignificant, but a number represent an appreciable loss in compressor capacity.

Suppose air costs six cents per thousand cu ft at 100 psi. Amount of air wasted per month from a ⅜-in. opening (based on a nozzle coefficient of .65 is 6,671,890 cu ft. At a cost of six cents per thousand cu ft, monthly loss is $400.31.

If size of opening is ¼-in., monthly loss is $175.25. A ⅛-in. opening loses $44.41; a 1/16-in., $10.94; and a 1/32-in., $2.73.

One of the best possible ways to determine the extent of air leakage is to find out how long the compressor must run to keep a specified pressure in the lines when they are completely shut off. By converting this time into amount of air compressed, the leakage can easily be calculated. Not only does careful leak-prevention maintenance more than pay for itself, but it may in some instances make increased compressor capacity unnecessary.

Distribution Losses

Another item that should be carefully watched is the collection of water or oil in the air lines. This, of course, may be so great that efficient and dependable operation of the compressed-air system becomes impossible. Compared with this, the expense of cooling the air to remove moisture after compression is almost negligible.

Savings are effected by proper controls for plants that use small amounts of compressed air over long periods. Such controls prevent the compressor from running during periods when air is not needed.

Remember that operating expenses far exceed the entire first cost of compressor equipment. Careful selection, thorough knowledge of compressor capacity and constant attention to maintenance details all add up to better performance and greater over-all economy.

Tables are computed on assumed values. Base figures, such as fuel-heat rate, fuel consumption per bhp and fuel cost, may not agree with local fuel figures and should be adjusted to prevailing values.

Better Maintenance for Large Synchronous and Induction Motors

How to take care of minor troubles before they develop into serious faults that cause unexpected shutdowns, expensive delays and repair bills, as told by H E Keneipp, service engineer, Westinghouse Electric & Mfg Co

▶ WHEN ELECTRIC MOTORS are installed, long trouble-free service is expected of them. But to attain this end they must be kept clean and inspected at regular intervals. If this is done most small faults will be found and corrected before they develop into serious difficulties that may cause a shutdown and expensive repairs.

Brushes and brush rigging. Adjust brush holders to clear collector rings by approximately ⅛ in. Don't let brush shunts touch each other or any part of the brush rigging. Fit brushes to rings by drawing fine sandpaper under each one in the direction of rotation, while pressing the brush against the ring until the brush-face contour is the same as that of the ring.

Brush-Spring Tension

Adjust spring tension to obtain a brush pressure on the ring of 2.5 psi for carbon, and 3.5 psi for metallized brushes. Make pressure equal on all brushes so that the total current divides equally between them. Brushes must move freely in their holders. If they have a tendency to stick, rub their sides with fine sandpaper and clean the inside of the brush holders pockets. Always use the grade brushes supplied with the motor as it is the correct one for best results.

Low-speed collector rings. Motors that have split rotor spiders also have split collector rings. Bolts at the split in the rings must be removed when assembling the spider.

Dowels are provided so that the halves of the collector rings can be accurately bolted together. If the ring halves do not fit together exactly, line them up by tapping with a rawhide mallet or wooden block.

All collector rings are turned concentric with the bore of the hub and, if care is taken in assembling the spider on the shaft, the rings will run true. An eccentricity of .01 in. is permissible on low-speed machines. If eccentricity is greater than this, slightly loosen the nuts on the collector studs and lightly tap the rings into position. A dial gage is convenient for measuring eccentricity.

To obtain best operation, measure clearance of the brush holders from the slip rings, and adjust the holders so that they clear the rings by approximately ⅛ in.

High-speed collector rings. High-speed collector rings must run true at all times. If they don't, grind or turn them to restore a smooth and true condition. Hand grinding or turning is not advised because this method may actually increase eccentricity.

Brush and ring troubles. Keep collector rings and brush rigging clean at all times. Dirt and dust accumulations may cause a flashover. Lack of proper care and maintenance cause most collector-ring troubles.

Remove black spots that appear on collector-ring surfaces by lightly rubbing with fine sandpaper. These spots are not serious in themselves, but they cause the rings to pit. If removed as soon as found, however, they do no harm to the rings.

Sometimes an imprint of the brushes

appears on the surface of the collector rings. This usually occurs on a machine subjected to moisture or acid fumes. When the machine is shut down, the fumes act upon the ring surface except where the brushes contact, and may cause a slight burning as the ring rotates.

Brush imprint on the rings may also be due to a slight unbalance in the rotor which causes a jerk or movement in the ring once in every revolution. This makes the brush jump slightly, producing a small arc that burns the brush imprint on the ring. Elliptic or egg-shaped rings may also cause this condition. Brush imprints caused by moisture or fumes occur at any point where the motor happens to stop. Imprints due to unbalance always occur at the same place on the ring.

Reverse Polarity

Since there is always an electrolytic action between the brushes and the surface of steel rings, reversing the polarity of the rings at intervals of two weeks improves synchronous motor collector-ring operation. Brushes and rings of wound-rotor induction motors may be burned if a heavy load is started with too little resistance in the secondary circuit.

Cleaning insulation. Keep electrical machinery free from accumulation of dirt that clogs ventilating ducts and forms conducting paths between bare electrical parts.

Compressed air effectively removes dirt which does not adhere to surfaces too tightly. Keep the air free from moisture and its pressure below 50 psi to avoid damage to the outer covering of the insulation.

When dirt contains grease or oil, a solvent usually is required to remove it. Clean by sponging with rags wet in the solution, applied sparingly, and thoroughly dry the insulation afterward, to thoroughly remove the solvent before it has time to damage the insulation. The solvent is generally benzine or carbon tetrachloride, or a mixture of the two. Use these compounds carefully because of their inflammable, explosive or toxic qualities.

Cleaning may sometimes be done with warm water, but washing must be rapid, and the apparatus thoroughly dried in an oven or with a jet of hot air to prevent the water soaking into the windings.

Cleaning by wiping with a dry cloth is often satisfactory and is recommended whenever it can be used. Do not use waste because lint may adhere to the windings, collecting dust, moisture and oil. If the insulation shows signs of dryness, clean and varnish it, preferably under the direction of a manufacturer's representative.

Check the air gap between rotor and stator cores with feeler gages to determine whether rotor is centered in stator bore to give balanced magnetic pull on rotor

Drying-out insulation. When a motor has been subjected to extreme dampness, drying out is necessary. Application of external heat is the simplest method, preferably with electric heaters or with hot air blown over the windings. Maintain the temperature of insulated parts, at not less than 105 F or more than 180 F. Do not hurry the drying process and continue it until the insulation resistance reaches a satisfactory value.

Insulation resistance. Insulation resistance measurements are made to determine the condition of the winding, and are especially useful when drying out a winding. Resistance may be measured either by a Megger or by a 500-v dc circuit and a 500-v dc voltmeter.

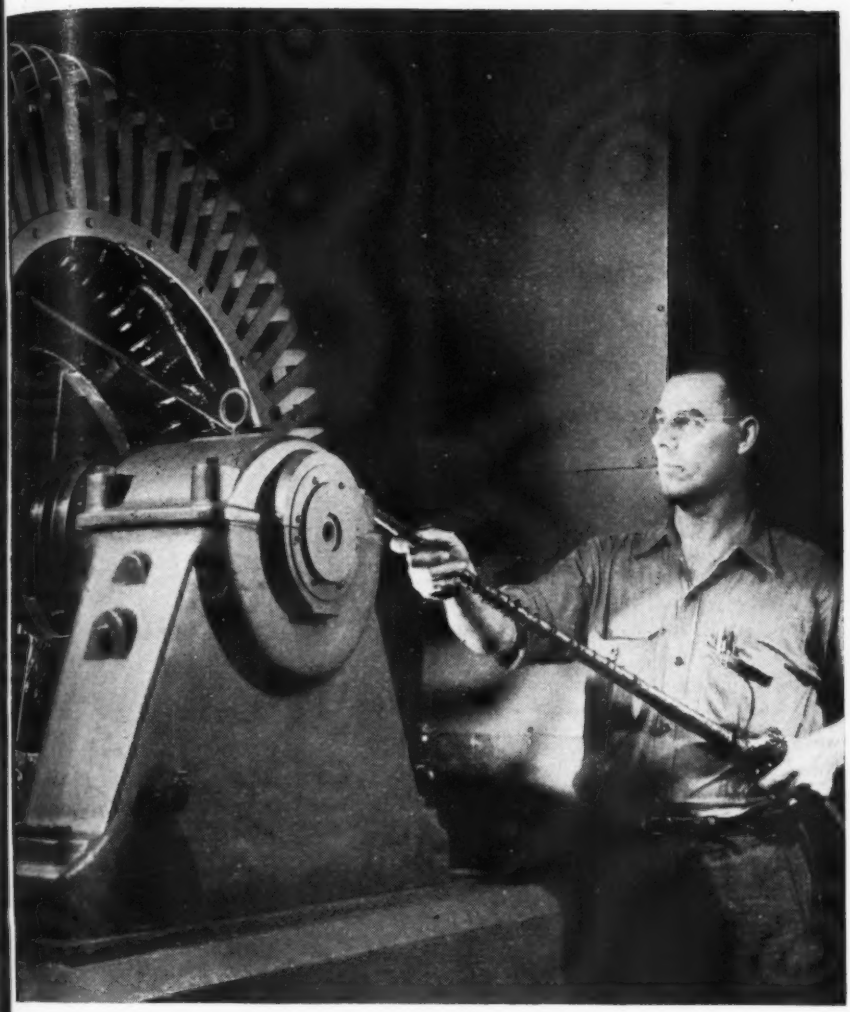
Sleeve bearings (1800 rpm and below). Operating at this speed, sleeve bearings are normally self cooled and ring lubricated. Before starting a motor, fill bearing reservoirs with the proper grade of high-quality lubricant, to level marked on the oil gage, or within ⅛ in. of the cup top, if an oil gage is not provided. Use an engine oil having a viscosity of 180 to 220 SSU at 100 F.

Check amount and condition of oil in the reservoirs and operation of the oil rings. At intervals of 6 to 12 months, depending on operating conditions, drain and flush bearing reservoirs and refill with correct grade of oil.

Shaft Currents

Certain pole and punching combinations have a tendency to produce circulating currents between shaft and bearings. When this condition exists, the outboard bearing is insulated to prevent current flow. Do not short-circuit this insulation. If oil pipe or electrical conduits are connected to the bearings insert insulated joints in them.

Sleeve bearings (3600 rpm). Motors that operate at this speed have flood-lubricated bearings. Three types of systems supply oil to these bearings. First method includes a positive-feed oil pump, mounted at the motor's outboard end, and driven from the end of



Blow dirt out of machine with moisture-free compressed air, but to avoid damage to the outer covering of insulation do not let pressure exceed 50 psi

the shaft. Oil drawn from a tank or reservoir mounted on the side of the frame is pumped through pipes connected to the bearings. Second method is similar to the first except that a small motor drives its oil pump. Third method supplies oil to the bearings from a central system.

To supplement the flood system of lubrication, bearings are sometimes provided with oil rings, which supply oil during the period required by the pump to fill the bearing supply pipes. When oil rings are used, the bearing housing is shaped to form an oil reservoir, which is kept full by the flood system. For the initial start, this reservoir must be filled by hand to insure the bearings being lubricated as soon as the shaft begins to revolve. It is not necessary to fill the reservoir again until the housing has been drained for cleaning.

For bearings of 3600-rpm motors, use only the best grade of turbine oil having a viscosity of 140 to 160 SSU at 100 F. Each bearing requires 0.75 gal of oil per min. Rate of flow must never exceed 1 gal per min. For oil systems integral with the motor, rate of oil flow is set at the factory and further adjustment is not required. When either of the other two systems is used, rate of oil flow must be adjusted by a valve, or orifice, before permanently connecting the bearing supply pipes.

Integral Oiling Systems

For the integral system, with pump driven from the motor shaft, the oil tank is located on the motor frame at a height to prime the pump automatically when the tank is filled to the lower level shown in the gage. Maintain oil level between the marks on the gage. A lower level may prevent the pump priming; a higher level, free drainage from the bearings.

For the system that has a separately driven pump and separately mounted tank, locate the tank as specified on the outline drawing. Interlock the pump-motor starter with the main-motor starter so that the latter cannot be started unless the oil pump is in operation.

Radiating surface of the oil tank and connecting pipes is usually sufficient to satisfactorily cool the oil and bearings. However, an oil cooler may be required under adverse operating conditions.

Anti-friction bearings. Large industrial motors frequently use ball or roller bearings when the motor takes end thrust or when the customer requires them. Anti-friction bearings in large horizontal motors are usually grease lubricated. They are packed with grease when assembled at the factory and require only the addition of approximately 1 oz (2 cu in.) of grease every three months. At intervals of approximately two years, depending upon the application, thoroughly clean the bearing and repack with grease. When repacking fill the bearing and seal cavities beside it approximately two thirds full of good-quality sodium-base grease of the channeling type.

Thrust Bearings

Vertical motors. Both synchronous and induction motors are frequently built in vertical types. They require either a Kingsbury or an anti-friction thrust bearing to support weight of the rotating parts of the motor and load.

Lubricate Kingsbury bearings with a good grade of engine or machine oil having a viscosity range of 200 to 250 SSU at 100 F for bearing speeds of 600 rpm and above, and 250 to 325 SSU at 100 F for lower-speed bearings. Examine the oil at regular intervals for contamination and acidity, replacing if necessary.

Keep bearing pots of anti-friction thrust bearings filled with oil to the level marked on the gage. The level may change slightly when the motor is running because of oil circulation and change in viscosity as the oil becomes warm. For these reasons, check the oil level when the machine is at rest. Use a good grade of engine or machine oil having a viscosity of 180 to 250 SSU at 100 F. Examine the oil at regular intervals for contamination and acidity. Replace if necessary, carefully cleaning and flushing the oil pot to eliminate chance of contamination.

Cooling of thrust bearings. Thrust bearings are usually self-cooled, but heavy thrust loads and high speed may require cooling in the oil pot, surrounding the bearing. Provide clean cooling water, free from sediment or corrosive compounds.

Guide bearings. Give them the same care and treatment as the thrust bearing, and use the same quality and grade of oil. Lower guide bearings are either anti-friction or sleeve. They are

(*Continued on page* 142)

WELDING
Uses Pounds To Save Tons

And is generally the answer to "How can we fix it?" Well-trained welders properly supervised can make repairs that save material as well as equipment-outage time, says R C Fitzgerald*, Consolidated Gas Electric Light & Power Co

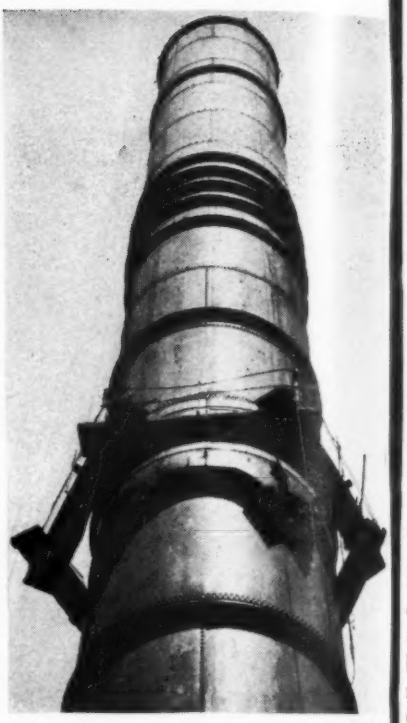


Fig. 1—Stack strengthened by welding annular channel sections to the joints

▶ WELDING has had to prove its worth in the power-generation field by hard engineering tests of workmanship and materials. Obviously, dependability and useful life of powerhouse equipment must be predictable within close limits because unforeseen outages are costly not only in dollars and cents but also in company-customer relationship.

When welded joints began to demonstrate their worth and dependability, they were adopted for many purposes and now not only serve in construction of turbines, boilers, piping and auxiliaries, but also help to maintain that equipment.

Although quality is always first requirement in power-plant maintenance welding, time often proves pressing on many jobs. The time for a given repair job has to be carefully estimated, and the estimate must be lived up to.

Variety of materials and shapes to be welded must also be considered. Metals that are repaired and not infrequently welded range from copper and its alloys to special stainless and heat-resisting steels. Such a variety requires a flexible welding procedure—that is, a greater variety of separate welding procedures. Hard and fast rules are meaningless. With the coming of higher steam pressures and temperatures, use of special steels has increased manifoldly, thereby increasing the necessity for welding these alloys.

Before welding can be used efficiently, safely and economically a well-organized and trained personnel must be assembled. This means not only skilled welding operators and good equipment, but adequate supervision. Many foremen who have welders in their group often know little or nothing about the welder's work. This, in effect, leaves the entire responsibility for a good job up to the individual welder, with the result that his limited knowledge and experience often get him into difficulties that adequate supervision could have eliminated.

Welding is every bit as much a separate trade, or art, as pipe fitting or carpentering, yet often it is delegated to the handy man with no supervision beyond his immediate foreman. Solution of the problem is to make all welders responsible to a welding foreman who decides on the welding procedures and checks the quality of the work.

Fig. 2—Welding this economizer tube saved cutting out the tube unit which would have required additional outage time as well as reducing economizer capacity

Powerhouse Maintenance

Maintenance work in powerhouses is roughly divided into: (1) repair of unforeseen failures which may or may not cause a shutdown of operating equipment. (2) repair of failures or worn parts found during routine inspection of machinery shut down for general overhaul.

However the job originates, the plant engineer and his maintenance organization must do the work right and get the equipment back on the line. This brings the welding foreman on the job

* Condensed from a paper submitted to the James F. Lincoln Arc Welding Foundation in its recent $200,000 Industrial Progress Award Program for reports on advances made by the applications of arc welding in design, fabrication, construction and maintenance.

The 2½-year welding study, in which 408 awards were made, indicated a possible annual saving by arc welding of 1825 million dollars, which includes 7 million tons of steel, valued at 271 million dollars, and 153 million man-hours.

to decide, first, if the job is weldable and, second, how it should be welded. In making his decision the foreman considers the following:

1. *Are materials weldable?*—Often the analysis of metals that must be welded is unknown and material that looks like one thing can easily be something else. When possible, nature of the materials is decided by some quick test such as: sparking with an emery wheel, acid attack, magnetic properties, or chipping the metal and observing the nature of the chips. The metal's behavior under the arc or torch is a good indicator of the analysis. Any one or a combination of these quick tests enables the foreman to predict weldability with a fair degree of certainty.

2. *Is the weld accessible?* Almost as important as weldability is availability, or ease with which a point can be seen, reached and welded. The welder must have room to see and to perform the maneuvers necessary to make the weld. Often welding must be done under the most adverse circumstances, and the foreman must determine the possibilities of making a strong weld.

3. *Welder personnel?* Selection of the particular welder to do the job is the next point to be settled. Choice depends on conditions under which he must work and the characteristics of men available. Some welders work better when the job is difficult and, conversely, others don't perform well unless welding conditions are entirely to their liking. Some men crawl into a tight place and make a good weld, while others, who could make as good a weld or perhaps an even better one, under ordinary circumstances, would turn out an unsatisfactory job. Also, some men get the knack of making one kind of weld better than others can.

4. *Welding process?* Having settled the first three questions, the welding process follows more or less automatically. Selection, of course, is one that gives best results in the shortest time. Whether we use gas or arc depends on the materials—their size and shape, location, and analysis. This includes other variables such as weld preparation, and rods or electrodes.

Compares Repair Cost

The following jobs illustrate how we have used welding during a two-year period of operating and maintaining 276,000-kw capacity of steam-generating equipment. Along with a description of the welding a cross comparison is made with an alternative method of repair, with cost estimated on experience with similar jobs.

Labor costs are based on average mechanic's wage for the two-year period, 1940-1941, plus 15% for supervision, insurance and other items. Material costs are based on known figures or on estimated quantities that would have been used if welding had not been considered possible.

Costs of machine idleness are sometimes more serious than those of maintaining equipment. Value of generation lost on account of outages varies throughout the year and with each piece of equipment. Factors influencing these costs for a given period are: (1) peak load or kilowatt demand, (2) average kw load, (3) availability and cost of power from tied-in electrical systems. Here are the welding jobs during the two-year period:

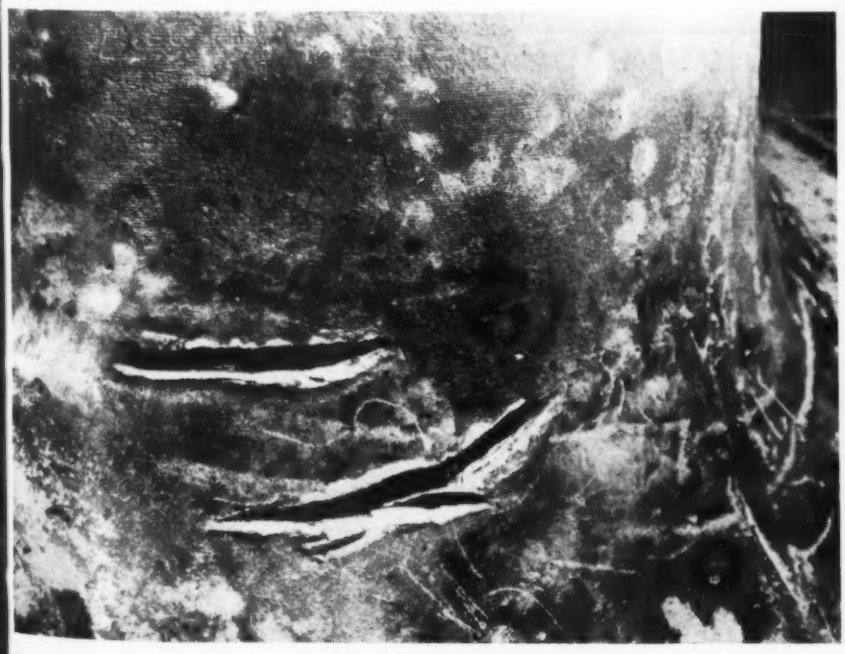


Fig. 3—These cracks in a steam manifold were chipped out preparatory to welding. Repair kept the header in service until a new one could be fabricated

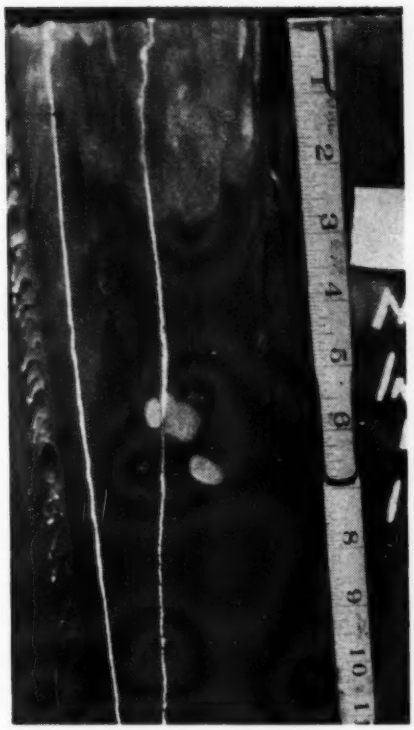


Fig. 4—Erosion in steel induced draft-fan blade after three months' operation

Comparative Costs

Cost of hard-surfacing fan blades:

Labor for hard surfacing and installing wearing plates	$552.60
Cost of welding material	328.50
Total cost for one boiler	**$881.10**

Cost of replacing fan rotors for three periods—aside from annual shutdown for general overhaul:

Labor cost for three jobs of reblading rotors	$2226.40
Cost of replaced fan blades	85.68
Cost of 4-day shutdown on boiler	6888.00
Total cost for one boiler	**$9200.08**

Emergency repair to economizer tube: An economizer tube for a h-p boiler sprung a leak at the end of the tube bank where it was easily accessible for repair. The crack was chipped out and welded with a mild-steel electrode, Fig. 2. Time consumed did not

(*Continued on page* 146)

Allow for Wrench Clearances on Piping Layouts

Arthur H Korn shows how much space to leave for wrench clearance when laying out pipe flanges for bolts with hex nuts or other bolted connections. Table lists clearance distances for one surface and for two at right angles

▶ WRENCH CLEARANCES are governed largely by the minimum arc through which a wrench must be swung when tightening or loosening a nut. The table below was prepared for double open-end wrenches in which the open end forms an angle of 45 deg with the center line of the wrench handle, Fig. 1.

The wrench dimensions assumed were listed on page 156 of *Product Engineering*, March, 1942. (This is a condensation of Mr Korn's article in that issue.) It is assumed also that the wrench is turned over after each pull—in short, that it takes twelve bites to turn a hex nut through one revolution.

When bolting up, wrench movement may be limited either because the wrench handle strikes an adjoining nut or the jaws contact the flange hub. Finally, of course, the outer end of the wrench may hit a wall or other obstruction.

If a 45-deg offset wrench is used, striking the adjoining nut and contacting the hub occurs in more or less the same wrench position on nearly all flanges having more than four bolts. Moreover, in this limiting position the wrench handle is almost tangent to the flange. These facts make the 45-deg offset wrench ideal for pipework. When necessary, clearance space required by a 45-deg offset wrench can be reduced by using alternately with it an 80-deg offset wrench.

Clearances necessary to bolt up the flange joints were calculated, Fig 2, for two sides of a rectangular boundary. The minimum clearance, *X*, from center of pipe to wall, ceiling, floor or any inclined straight surface, must be measured on a pipe center line that is straddled by the bolt holes. When this minimum clearance *X* is used, the clearance *Y* from a second surface at right angles to it usually becomes larger than *X* in the same plane. The circle described by the radius *R* represents the maximum area swept by the wrench when not impeded by any objects other than the flange itself.

While this table will generally serve, remember that wrenches have never been completely standardized. If the actual wrenches for the job are known, the draftsman can work out his own clearance tables by graphic methods, swinging paper wrench templates on the drawing board.

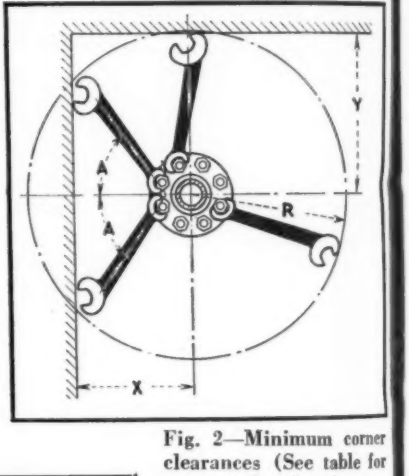


Fig. 2—Minimum corner clearances (See table for numerical values.)

FLANGED PIPE CLEARANCES

Required for double open-end 45-deg offset wrench
Dimensions X, Y and R in inches; A (angle) in degrees

Nominal pipe size	Steel flanges: 150 psi; Cast-iron flanges: 125 psi				Steel flanges: 300 psi; Cast-iron flanges: 250 psi				Steel flanges: 400 psi				Steel flanges: 600 psi				Steel flanges: 900 psi			
	X	Y	R	A	X	Y	R	A	X	Y	R	A	X	Y	R	A	X	Y	R	A
½	4.8	9.5	9.8	74									5.1	9.6	10.0	72				
¾	4.9	9.6	10.0	75									6.3	11.9	12.4	72				
1	5.3	9.7	10.2	73									6.5	11.0	12.5	71				
1¼	5.5	9.9	10.4	72									6.7	12.1	12.7	71				
1½	5.3	10.0	10.6	75									7.4	14.4	15.1	73				
2	6.2	12.4	13.1	77	9.7	11.8	13.2	54					9.7	13.0	13.3	54				
2½	6.7	12.7	13.5	82	11.7	14.8	15.7	53					11.6	15.6	15.8	53				
3	6.5	12.9	13.7	77	12.6	15.8	16.1	47					12.0	15.9	16.2	54	13.3	16.3	18.7	57
3½	9.5	13.7	14.2	64	12.4	16.3	16.4	54					14.3	18.3	18.6	50				
4	9.8	13.9	14.5	64	12.3	16.5	16.7	55	14.4	18.6	18.8	51	14.0	18.9	19.2	56	17.1	20.9	23.8	55
5	12.8	16.8	17.1	54	13.3	17.2	17.4	53	14.8	19.3	19.5	52	15.6	21.9	22.3	59	18.9	23.3	26.8	57
6	13.6	17.3	17.6	51	14.6	17.6	18.1	50	16.3	19.7	20.1	48	18.4	22.2	22.8	47	20.3	24.7	25.5	48
8	14.4	18.3	18.7	53	17.3	20.8	21.4	50	19.2	23.0	23.5	47	21.2	25.4	26.1	46	24.9	28.2	31.2	48
10	18.7	19.3	22.0	44	21.5	21.5	24.6	40	23.8	23.8	26.7	38	26.0	26.0	29.9	39	28.5	28.5	32.7	39
12	19.3	20.5	23.4	49	24.3	24.3	28.0	41	26.5	26.5	30.1	39	28.2	28.2	31.0	34	31.0	31.0	34.0	34
14	21.5	23.4	26.4	51	26.4	26.4	29.2	38	28.6	28.6	31.3	34	30.8	30.8	33.8	33	33.3	33.3	36.6	33
16	23.9	23.9	27.6	44	28.3	28.3	32.4	38	31.5	31.5	34.5	35	34.0	34.0	37.5	34	36.3	36.3	39.8	34
18	27.1	27.1	30.5	40	30.8	30.8	33.6	35	33.5	33.5	35.7	30	37.2	37.2	40.6	33	41.4	41.4	45.4	33
20	28.6	28.6	31.6	38	31.7	31.7	34.7	36	36.4	36.4	38.9	30	39.1	39.1	42.0	30	44.3	44.3	48.8	34
24	32.8	32.8	36.0	37	37.7	37.7	41.4	36	42.7	42.7	45.5	31	45.6	45.6	48.5	30	55.0	55.0	59.2	33

Fig. 1—Double-end offset wrench, used as a basis for calculating clearances

Coal Shortage Threatens Industry
—*Ickes Warns*

"This country faces an actual . . . shortage of coal. It has been necessary to establish a system . . . that will make coal available to those . . . who need it most. ***Consumers with large stocks will be called upon to share their coal with others who must have fuel to keep from closing down.*** Consumers . . . in a critical situation . . . should state their situation fully to the Solid Fuels Administration. ***It will be necessary for all consumers to conserve . . . the largest savings must be made . . . by those firms who have paid the least attention to conservation.*** The Solid Fuels Administration is organizing the National Fuel Emergency Council which eventually will make available skilled engineers for inspection and advice . . . in many key cities. **"**

▶THE SUCCESS of the nation's current effort to solve its most critical fuel situation since the start of the war must rest to a considerable extent on the full and voluntary cooperation of industrial coal consumers with the Solid Fuels Administration's distribution and conservation programs, Harold L Ickes, Solid Fuels Adiminstrator for War, states in a resumé of the current situation and the Government's moves to meet it. Mr Ickes' statement was prepared at the suggestion of POWER.

"It would be extremely helpful to begin with if every industrial consumer would realize that this country faces an actual and not a mythical shortage of coal," Mr. Ickes says. "It is quite true that some of the more fortunate consumers have large stockpiles and likewise have contractual commitments from producers for current supplies. Unfortunately, it is equally true that many consumers were actually unable or too improvident to protect themselves in advance of the emergency which has arisen. However, some arrangement has to be made to take care of them because we cannot let our war activities bog down for lack of fuel. Consequently, it has been necessary to establish a system of coal distribution by orders and regulation which will make coal available to those engaged in vital war activities who need it the most.

"It is to be regretted that these orders and regulations sometimes impose upon the most provident, the most cooperative, consumers some additional cost, some additional work, worry, and irritation. I am sure that these disagreeable impacts of the distribution program will be borne with good grace by everyone who realizes that the fuel emergency can be met only at the cost of some sacrifices."

The Government's coal distribution program now in effect is based on the fact that an actual deficit exists between production and requirements. It is aimed at bringing about an equitable distribution of the available supply of coal. It calls for the leveling of stocks until production and requirements are brought into balance.

The orders and regulations issued by the Solid Fuels Administration are intended, first, to make available for such purposes as the manufacture of steel and other processes the special coals that are indispensable to the prosecution of the war.

"I am sure that there is no need to dwell at any length on the advisability or equity of this phase of the program," Mr. Ickes says. "Anyone who is more interested in the ultimate victory of this country in the war than in his own individual affairs will agree that it is both wise and necessary."

Second in importance, as far as industrial consumers are concerned, is the phase of the distribution program that deals with Great Lakes shipments. By reason of the late opening of navigation on the Lakes last spring and the work stoppages in the mines, supplies of coal are now three and a half million tons less than dock supplies at the same time last year. All the coal needed must be shipped before the navigation season ends because it is uneconomical and often impossible to serve these areas by rail transportation. Consequently, the Solid Fuels Administration has ordered producers, after fulfilling their commitments for special-use coal, to fulfill commitments for Lake coal before November 15.

To comply with this order it has been necessary for many producers to ship coal to the Lakes instead of fulfilling commitments to other consumers who are protected by stocks. After November 15 production now going to the Lakes will be available elsewhere.

"Meanwhile, many provident con-

(*Continued on page* 154)

THE OLD CHIEF

FIREMAN, SAVE MY CHILD!

The brave firemen remained there grinning until the Old Chief came

The Volunteer Firefighters make things hum when the Old Chief gives the fire-drill signal. Wrong signal, eh? Sure they can handle that, too. Another in the series by William Doran, chief engineer, Essex Co Sanatorium, Windsor, Ontario

Somewhere along the line I lost a photograph of the Volunteer Fire-Fighters of the old plant. I was proud to be a member and always regarded the fire drills and the occasional actual fire killings as enjoyable interludes in the ordinary grind.

The first Saturday in every month was Fire Drill Day and we never knew what the Old Chief would think up. BANG would go the fire bell and on a big blackboard near the time office there would be written the scene of action. It might be *oil fire at main stores*, in which case we would grab the round-bottomed sand buckets from the wall and head for the stores where we would find the Old Chief calmly observing his stop watch.

Then he would check us over to see that the timekeeper was there with the master keys, the carpenter with his ax, the beltman with his ladder, the electrician with a smoke mask, and the rest of us with our sand pails or water pails, as the case might be. The standpipes and hose lengths were not standard equipment until many years afterwards, but we had bucket brigades that could pass water to any corner of the factory with the skill born of many practices.

Grandstand Play

When a change in our water service made hose reels possible, we staged a big display. A bonfire was set in the courtyard and it was arranged that when the fire bell sounded, Red Hogan was to appear with a hose and raise his arm as a signal for the water to be turned on. But he forgot about raising his hand, so there was the bonfire blazing and no water.

Red turned back into the factory to see what the trouble was, just as the water came on soaking the crowd gathered at the windows to see the fun. He retraced his steps in confusion tilting the hose high so that he unfortunately drenched the manager and all the office staff who were leaning out of the second-floor windows. It took the Old Chief a long time to live down that first hose display. Office girls would ask him whether they could borrow his bathing suit for the next fire drill.

Excursions and Alarms

Modern chemical extinguishers were added to our equipment as time went on. First came the carbon tetrachloride type for electrical, or Class Three fires, as we called them. Then came the soda and acid extinguishers for ordinary fires and the foaming type for Class Two, or oil fires. Later on, a few CO^2 cylinders were placed at vulnerable points, and within the last few years all the hose have been equipped with the new low-pressure fog nozzle. The latter just has to be seen to appreciate its usefulness.

Looking back over the alarms we answered, full ninety percent were caused by misused gasoline, unnecessary rubbish piles and careless smokers. Perhaps the worst fire we ever handled was the result of a man using a spray gun loaded with gasoline to degrease a machine that was slated for repainting. The excitement started when the fumes traveled along the ground to an autostarter. To make matters worse, there were about 60 gallons of varnish stored near at hand. We kept a stream of water on it while a CO^2 cylinder took care of the rest of the blaze.

About 1928 we established the location system. It meant that instead of rushing to the time office when the alarm sounded, a telltale number of blasts on the factory whistle told us the exact location of the call. Thus, two blasts repeated several times indicated the shipping room, three blasts another point, and so on.

On one of our drills, the Old Chief gave the word for five toots to be sounded. This normally sent the gang to the garage. But on the fourth toot the chain to the whistle broke, with the result that all the firemen with their hose, axes, buckets, etc, barged into the sample room where our genial sales manager was entertaining a number of out-of-town customers with *terribly illegal refreshments*. The brave firemen remained there grinning until the Old Chief came and hauled them off.

How to Keep Injection Systems on the Job in Wartime

For good diesel performance, make sure fuel and fuel-injection systems are in first-class shape. G H Menefee, USNR, gives practical pointers on maintenance

▶THE FUEL SYSTEM is the heart of a diesel engine. Scarcity of both material and skilled precision workers makes injection-system parts hard to obtain today. Thus care of the injection system is more essential than ever. To avoid grief later, keep a close check on all parts of a fuel system from supply tank to engine cylinder. There is no better time than now to start preventive maintenance.

As a first step, examine the supply and day tanks to see that they contain no rust, sediment or moisture. Next, check the supply-tank vent to make sure that rain or dust cannot enter. It is advisable not to paint the interior of such a tank, but if this has been done, make sure that vibration has not caused paint to flake off and enter the system.

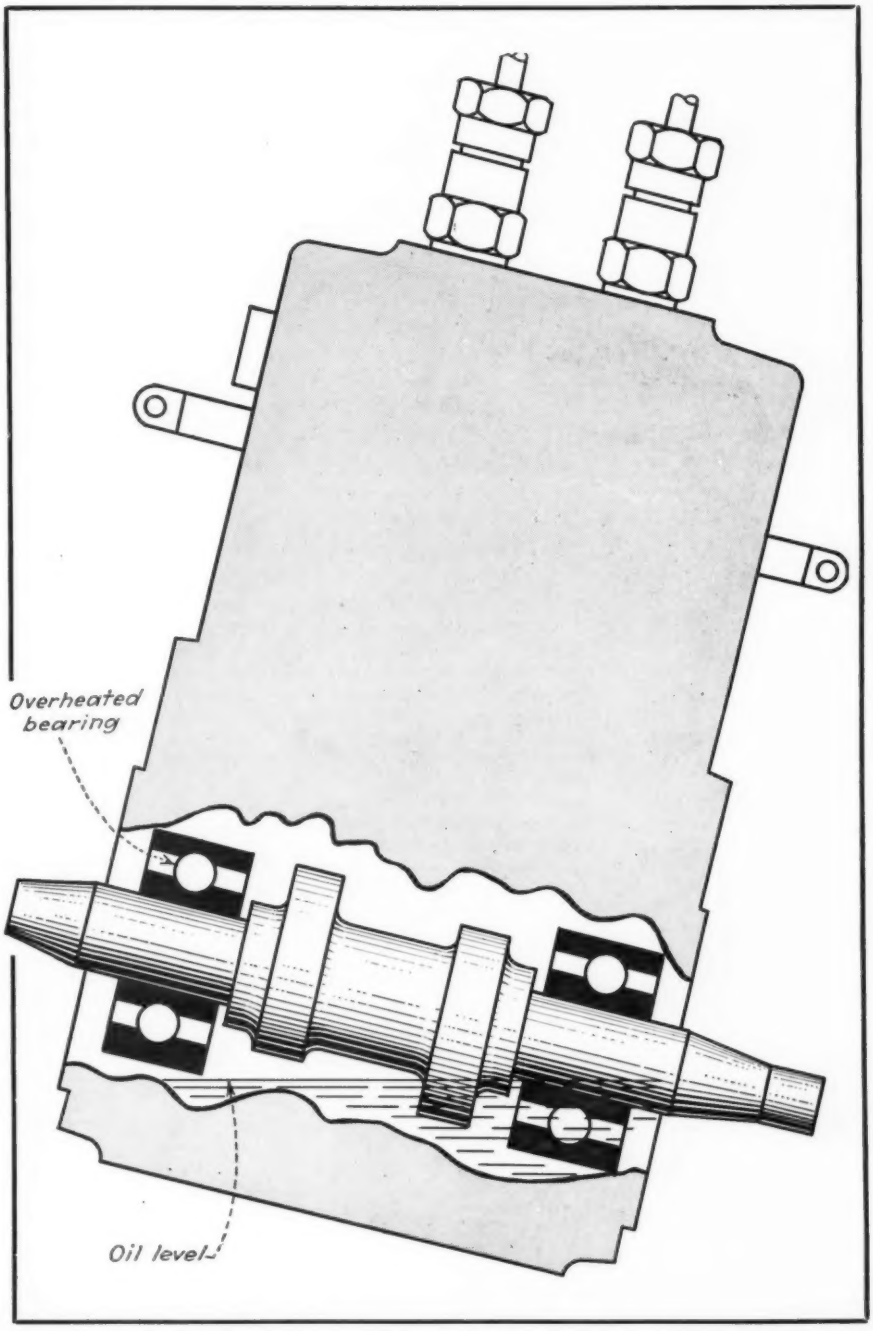
Go over the fuel lines carefully for leaks. Any air entering the fuel system carries dust, which may clog or score the parts. The air itself may cause the pump to air-bind.

Clean Filters, Strainers

Clean filters and strainers at least once a week, and oftener if the engine operates constantly. Wash edge filters in a solvent, such as carbon tetrachloride or naphtha, and blow out from the inside with filtered air to remove deposits on the outside of the filter element. The element may then be blown dry from the outside. Reinstall filters immediately or put them under cover; they collect dust and dirt quickly in the open. When the cartridges, in filters with replaceable elements, start to turn dark, they should be discarded because there is no good way to clean them. But if no spares are to be had, clean by soaking in a carbon solvent and reinstall, since a slightly dirty filter is better than no filter at all.

Discard filters made of sintered copper when they become dark and gummy deposits appear in the pits of the cop-

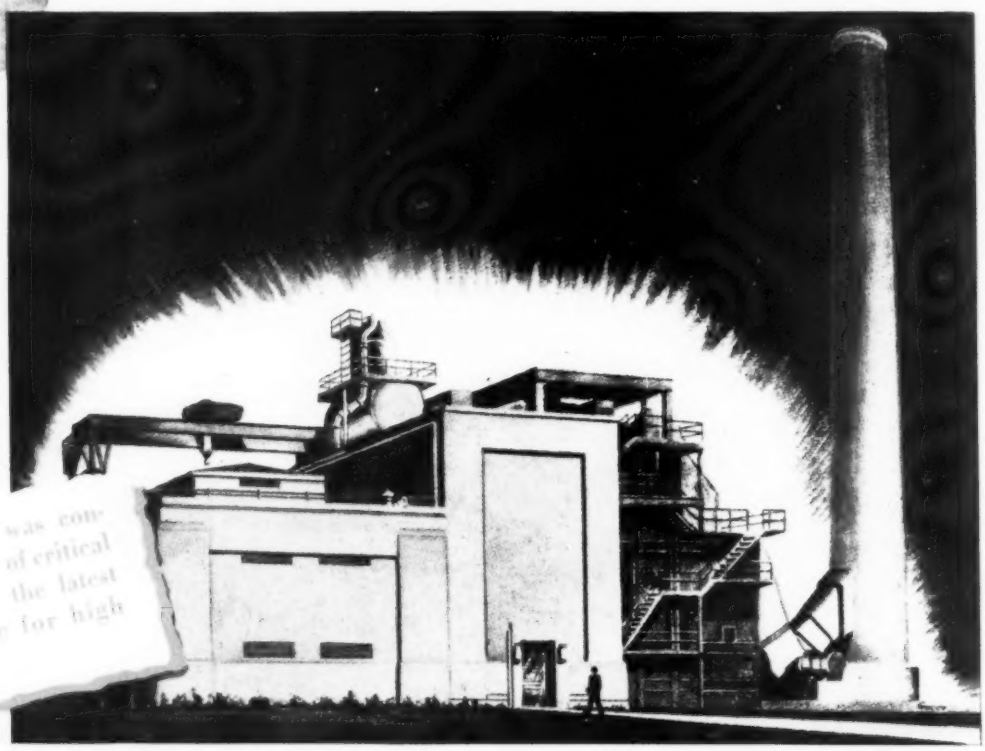
(*Continued on page* 98)



Slope of marine engine may throw forward bearing of injection pump above oil level. Stop after drain and let forward drain regulate oil height in pump sump

ELECTRIC POWER

. . . never too late nor too little



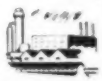
Designed in April, 1941, it was constructed with a minimum use of critical materials, and it embodies the latest developments which make for high efficiency.

Another power plant is dedicated!

The wheels of industry are driven chiefly by electrical energy, which speeds production, reduces costs, multiplies manpower. The new steam electric generating station shown above will add nearly 50,000 horsepower to drive the wheels of SOUTH TEXAS industry.

Designed in April, 1941, it was constructed with a minimum use of critical materials, and it embodies the latest developments which make for high efficiency.

Today's electric power demands were foreseen long before the United States entered the war; but the new power plant, which today is meeting those demands, is dedicated to help win the war for freedom—and to the more than 540 employes of the Houston Lighting & Power Company who have left their families and jobs to enter the armed forces of their country. When victory is earned, this plant will be named for one of their number.



The war industries in the area served by the Company are extremely vital to the war program. Ships, steel, magnesium, synthetic rubber and petroleum are but a few products representative of South Texas' mighty contribution to ultimate decisive victory.

To provide dependable, low cost electric service to these industries and to the people of South Texas who man them is this Company's privilege and responsibility. To that end the Houston Lighting & Power Company dedicates —not alone the new power plant—but its manpower, resources and experience.

HOUSTON LIGHTING & POWER COMPANY

Reprinted from The Houston Press, July 1, 1942

RILEY

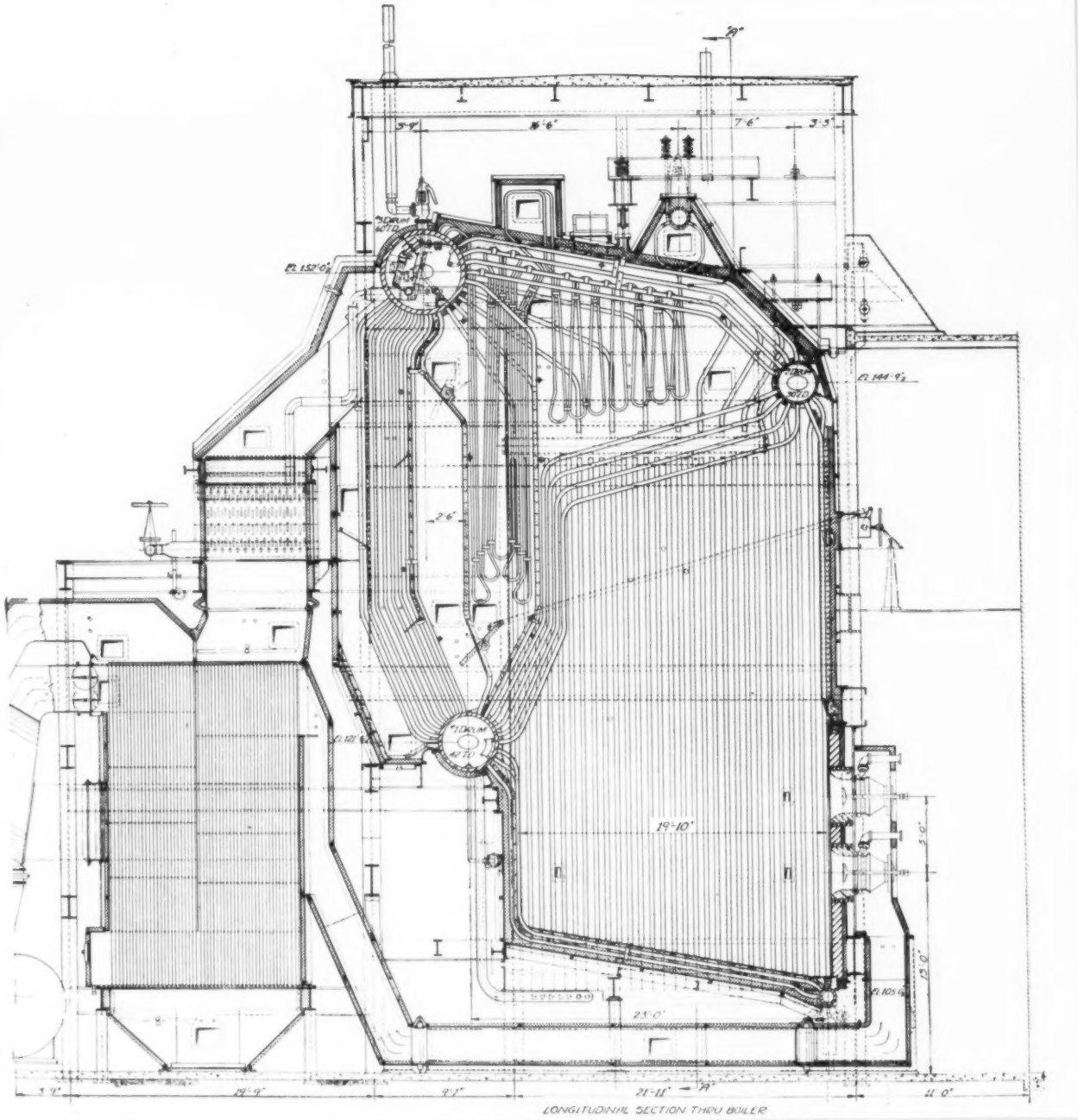
STOKER CORPORATION, Worcester, Mass.

Boston New York Philadelphia Baltimore Buffalo Cleveland Detroit
Chicago St. Louis Cincinnati St. Paul Kansas City Denver Seattle
Portland Los Angeles Houston New Orleans Atlanta Memphis

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

- STEAM BY RILEY ★ ★



HOUSTON LIGHTING & POWER COMPANY

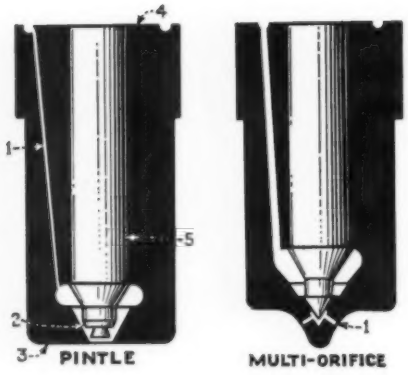
400,000 lbs./hr. 1000 lbs. Pressure 905F°. Steam Temperature

RILEY STEAM GENERATING UNIT

Houston Lighting & Power also installed a 250,000 lbs./hr. 950 lbs. 910° F. Riley Unit in 1938

A few additional Riley Central Station installations

- Union Electric Co. of Ill.
- Union Electric Co. of Mo.
- Florida Power & Light Co.
- N. Dakota Power & Light Co.
- Interstate Power Co.
- Carolina Power & Light Co.
- Iowa-Illinois Gas & Electric Co.
- Central Illinois Light Co.
- Northwestern Public Service Co.
- Upper Mich. Power & Light Co.
- Penn. Edison Co.
- Southern Ind. Gas & Elec. Co.
- City of Los Angeles, Calif.
- Central Ohio Light & Power Co.
- Otter Tail Power Co.



Check pintle nozzle (left) to make sure that fuel passage (1) is clean and open, needle-valve seat (2) is clean and tight, tip body (3) is free of pits and orifice of carbon; spray-tip seat (4) has no pits or scratches; and needle valve (5) is free of scores. Check orifices (1) of multi-orifice nozzle (right) with wire of proper size to see whether hole is worn or clogged.

per. If elements are only slightly dirty, wash in solvent and blow out from the inside with air. Holding the spout of an oil can against the filter bottom and squirting oil through the element shows whether the filter is sufficiently open for fuel to pass. Never use a filter of any kind that does not permit fuel to pass freely.

Lubricate fuel pumps carefully, following the manufacturer's instructions. Units lubricated by the engine, such as common-rail and individual metering pumps, should be watched. Although they generally receive ample lubrication, oil tends to form a gum around the springs and the bottom of the pump plunger. This may interfere with governor action by causing rack and gear to stick. Pumps mounted in a single housing usually have their own oil sump. In marine installations, forward pump bearings burn out frequently from lack of lubrication. In pumps furnished with two oil drains, the oil height is regulated by level of after drainhole because a marine engine slopes on its foundation. This puts the forward bearing above the oil level. The only solution lies in stopping the after drain, letting the forward drain regulate oil height.

Cleanliness Essential

Keeping the outside of injection pumps scrupulously clean prevents possible entrance of dust or moisture. If the engine is near a window or porthole, take steps to prevent entrance of rain or spray, which would rust exposed pump parts. Often rust enters the system when lines are broken to free them of air, or for routine inspection. Rust may also enter along the pump drive shaft, scoring the bearing. Rust on the control rack causes it to bind. Always clean connections with fuel oil or kerosene before breaking fuel lines at pumps or injectors. Dirt may enter the system if connections are broken before cleaning. After they are broken, cover openings in the fuel pump with lint-free rags or metal caps cut to fit. Cellophane does a good job also, and is obtained easily.

Fuel-Pump Inspection

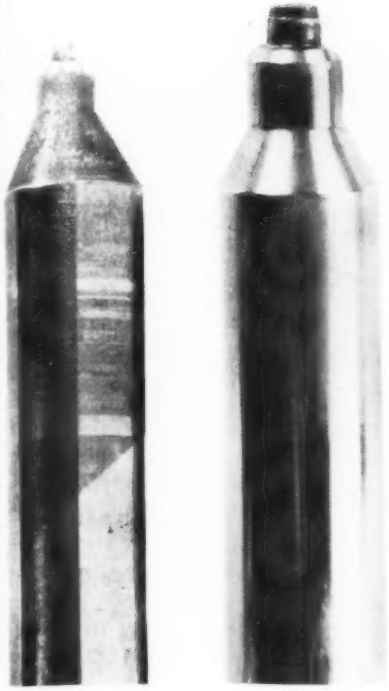
Inspect and overhaul fuel-pump with extreme care, keeping the parts of each unit separate from the others. The plunger and bushing, as well as the check-valve parts, are lapped together and cannot be interchanged. As a first step, dismantle the pump and clean all parts thoroughly with air and a carbon solvent. Unless the pump is to be reassembled immediately, dip the parts in clean fuel oil to prevent rusting. A light flushing oil proves even better for this purpose and should be used if the pump is stored before being put into service.

Examine pump threads to see whether they are broken or burred and likely to break off in the pump. Inspect the metering tip of the plunger and the lips of the helix to see whether they are scored or chipped. A magnifying glass proves helpful in this work. Discard a plunger that is chipped or scored; it cannot be lapped smooth again. Chips on the helix lips change the pump timing, while chips on the plunger end score the bushing. Examine bushing under strong light. Scoring generally occurs near the port, which gives the effect of larger ports and causes a decrease in amount of fuel injected. If scratches are found, discard the bushing.

Check rack and gear for burrs or damaged teeth. Injuries to these parts affect the governor action. In extreme cases, control may be taken away from the governor by the rack and gear sticking in an open position, which causes the engine to overheat badly.

In examining the spray tip to see whether the holes are enlarged, insert a hard brass wire of the proper size in the orifice. This also serves to clean out any carbon which may have collected in the holes. If orifices are en-

Water in the fuel eroded the spray tip at left; tip at right is in good shape



Needle valves at left show signs of damage. Dark rings around body of valve at far left indicate overheating; needle would probably have warped or seized if left in engine much longer. Note the scratches caused by dirty fuel along body of valve immediately to the left. This permits fuel to leak past the valve

Fuel-pump plunger at right shows scores caused by dirty fuel. This prevents pump from building up proper pressure and keeps the cylinder from carrying its proportionate share of the engine load

larged more than 0.003 in., replace the tip, since excessive enlargement destroys the spray pattern and causes poor atomization.

On pintle nozzles, examine the nozzle face for pits. Around the orifice they cause distortion of the fuel spray and make the nozzle carbon more rapidly. If they are not deep, remove by careful grinding on a fine emery wheel. This practice should be avoided when possible, but if you cannot buy new tips, it is better to attempt grinding than to use a pitted tip.

Examine the needle-valve seat for scratches or pits. Remove any scratches or pits by lapping, using a lapping compound of 600 to 800 grit. As a substitute, use jeweler's rouge or pumice powder and, in an emergency, a good grade of metal polish. Chuck the needle valve in a small hand drill. Do not bear down hard as the weight of the drill is enough. Dry the inside of the tip thoroughly to prevent lapping compound from sticking to the sides of the tip or needle and ruining them. Place a small amount of compound on the seat of the needle valve, spreading it with a match stick. Grind the seat as little as possible to secure a good fit and be sure to rotate the valve in both directions.

Some injectors have flat check valves, which should be lapped on a plate until surface scratches or oil stains disappear. Dress the seat in the same manner. Never lap a flat check valve to its seat; lap them separately to a plate. To find burrs on a flat check valve, slide it across a perfectly clean part of the lapping plate. Though hard to see, these burrs must be found because they prevent the valve from seating properly.

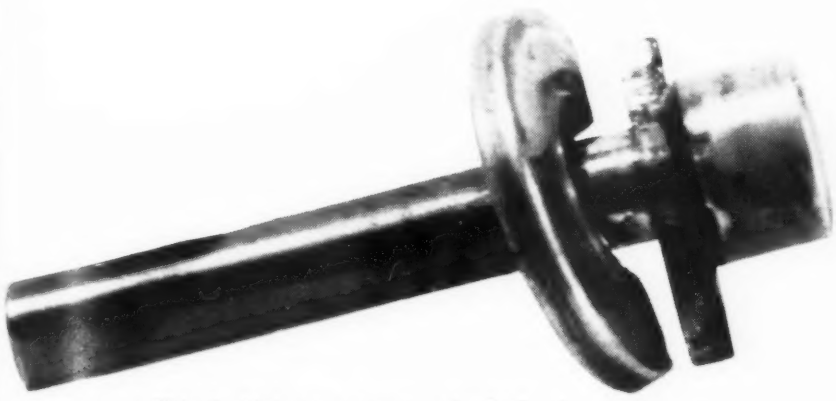
Ball check valves likewise should not be lapped to the seat. If no new check valves and seats are available, take a steel rod of slightly less diameter than that of the ball and turn the end to the same radius as the ball. Do this in a lathe. Case harden the turned end and lap in the seat with it, using an extremely fine compound. After dressing the seat, place the ball check on it and tap lightly with a brass rod. If the spring is weak and the valve opens too quickly, spread the coil slightly with a screw-driver. This makes the spring stiffer and raises the opening pressure of the valve. However, it is much better to replace the spring if it is possible to secure a new one.

Spherical Check Valves

Spherical check valves may be polished against the seat, using a metal-to-metal contact. Never use lapping compound on spherical valves.

If injectors have springs in the tips examine them for bright spots on the coils. Presence of such spots indicates that the spring rubs against the side of the tip. Springs in this condition are weakened and must be changed because they permit the valve to open at too low pressure. They are also liable to chip and score the tip or stop up the orifice.

Diesel injection equipment is delicate, practically all parts being machined to high precision. Only a skilled mechanic should service fuel pumps and injectors, and he should work in a segregated part of the shop which is kept immaculately clean. Some phases of the maintenance procedure may vary with different types of injection system. However, the pointers in this article, plus good judgment, should solve any problems that arise.



This fuel-injector pressure pin broke in service

Armstrong traps mak

56.25% LESS BOILER CAPACITY NEEDED

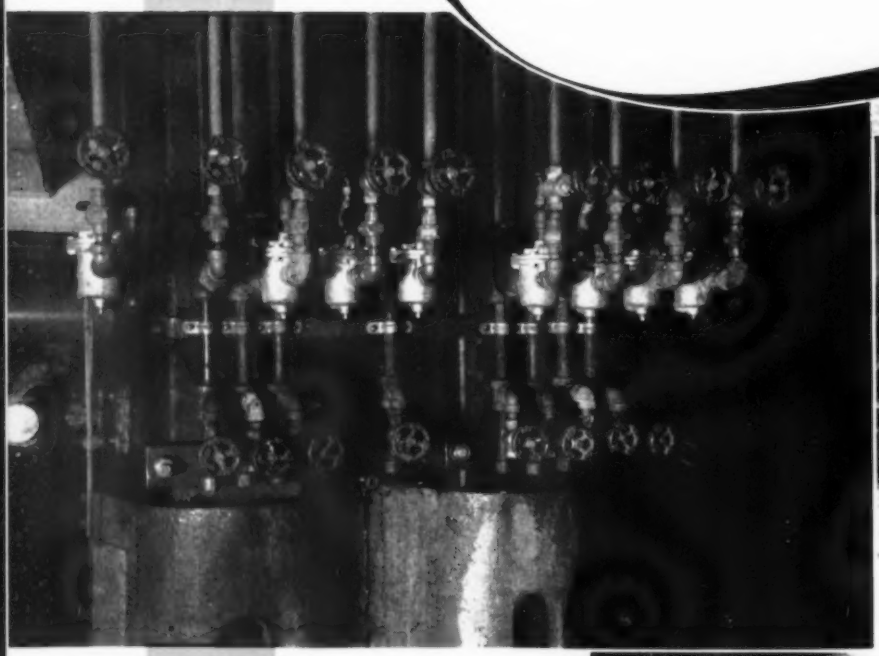
The Midland Chemical Company, Dubuque, Iowa, had placed an order for a new 125 H.P. boiler, but found that the recommendations of an *Armstrong Trap Representative* for a new return system and Armstrong Trapping so increased efficiency they were able to change the order to an 80 H.P. boiler instead!

Fuel oil consumption was cut from 1,500 down to 700 gallons a week.

The boiler room did not have to be enlarged as would have otherwise been necessary.

Faster heating and higher, more uniform temperatures were secured on process equipment.

IT'S A GOOD HABIT TO CALL IN AN ARMSTRONG TRAP MAN IF YOUR PROBLEM HAS TO DO WITH STEAM.



ARMSTRONG *Inverted Bucket*

Boilers Bigger!

When Armstrong Traps replace inefficient drainage devices or old, obsolete traps, the resulting steam saving usually is equivalent to a sizeable increase in boiler capacity. Any engineer naturally will question just how this steam saving is accomplished. The answer is simple.

STEAM TIGHT VALVES. Armstrong valve parts remain steam tight for a long time. This is due to such design and construction features as:

1. Valves and seats are water-sealed at all times.
2. Valves and seats are made of chrome steel. The parts are heat treated after machining. The ball valves are precision ground. Valves and seats are lapped together. Fussy operations, but they pay in steam savings.
3. Free floating lever design lifts valve to seat without leverage, thereby minimizing wear.

AUTOMATIC AIR ELIMINATION. This saves steam in several ways:

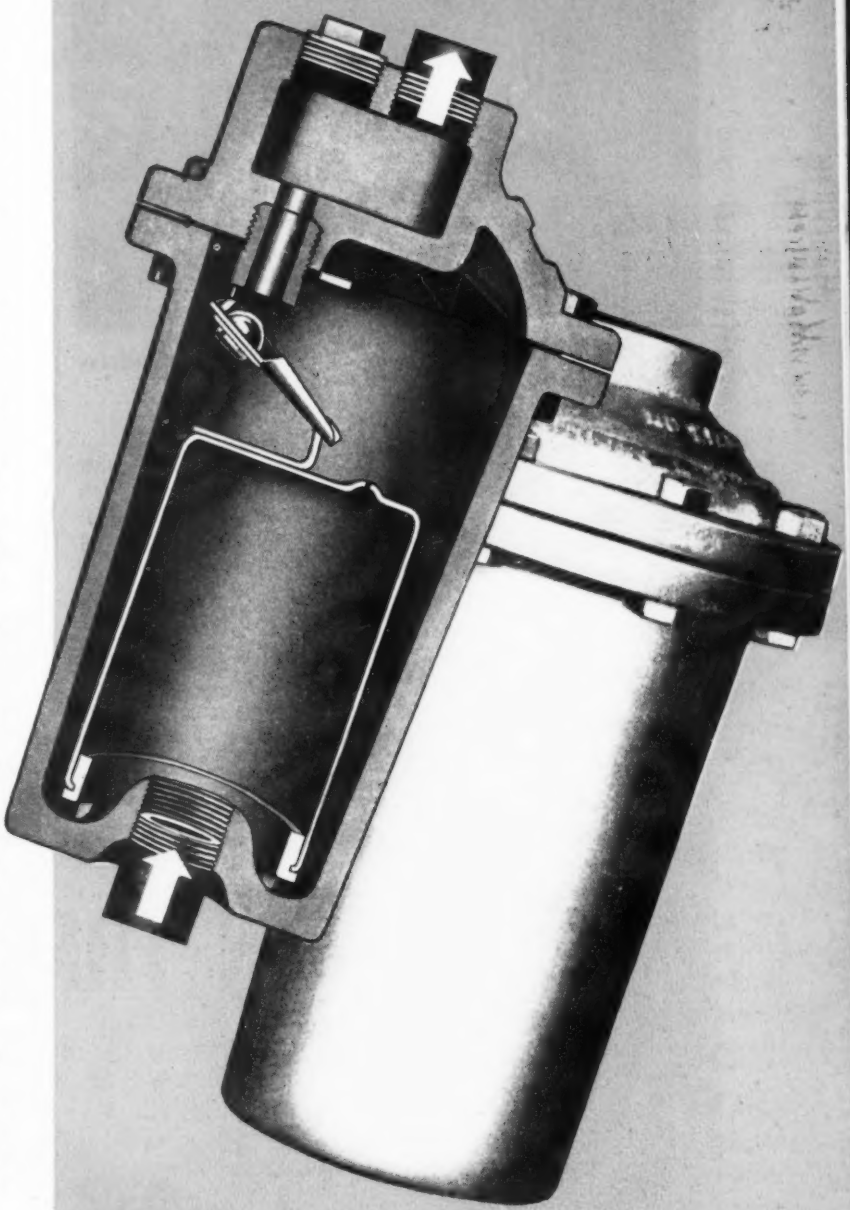
1. No manual blowdown necessary to rid pipe or steam heated unit of air.
2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

SELF-SCRUBBING ACTION. This saves steam because:

1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

Armstrong originated the inverted bucket trap in 1911. For more than thirty years, the Armstrong Machine Works has specialized on making inverted steam traps. During this same period, Armstrong Representatives have specialized on mastering trap selection and installation problems. Call your Armstrong Representative the next time a trap problem rears its ugly head.

ARMSTRONG MACHINE WORKS
812 Maple St. • Three Rivers, Mich.



HEY, MAN! DON'T DO THAT!
SILLY, ISN'T IT?
BUT IT'S JUST AS SILLY TO HAVE TRAPS THAT DON'T REMOVE AIR FROM STEAM SPACES, OR NO TRAPS AT ALL

STEAM TRAPS

HURRICANE HEADACHE

Thirty minutes after a Texas hurricane hit the giant oil-refinery cooling tower salvagers faced this mass of debris

▶ THE HURRICANE which roared across Houston, Texas, last July 27 left in its wake the tangled debris of a 50-ft-high 1000-ft-long cooling tower, vital to the operation of a Shell Oil Co refinery making high-octane gas for Army planes and toluene for TNT. Combined efforts of Shell Oil, Fluor Corp Ltd of Los Angeles, builders of the tower, the Southern Pacific Railroad and the ODT put the tower back on the job in the phenomenal time of three weeks. Here's how it was done, as recently released by the War Dept:

Shell employes started salvage, facing winds that reached a peak of 132 mph and braving flying debris and lashing electrical wires. Lyle Kendall, chief engineer of the refinery, volunteered to make the 21-mile drive to the nearest office of Fluor Corp, all other communication being cut. He completed the journey, which would ordinarily take 45 minutes, in five hours. Live wires, smashed vehicles, chunks of roof tops and deep water frequently blocked his path.

Kendall's arrival at the Fluor office started the Los Angeles plant on a 24-hr schedule. ODT in Washington and the Southern Pacific, operating between L. A. and Houston, set up schedules to bring new parts to the salvagers. As parts were finished they went directly into various types of express and baggage cars. These were hooked to fast passenger trains and handled as express rather than freight. The Port Terminal Railroad running to Deer Park rushed the shipments to the refinery as fast as received from the West.

Shell employes volunteered to work extra hours; the Fluor Co assembled a crew of skilled workmen from the Texas area to supervise the job; other suppliers to the oil industry offered both materials and personnel. Working at top speed, and sleeping on the refinery premises in some cases, the salvage workers made it possible to resume partial production in a few days, and at the end of three weeks the refinery was back on regular schedule.

Fifty-six cars in all hauled the parts from Los Angeles to Houston, at a cost ten times ordinary freight charges. The Friday-night-to-Monday-morning shipment with which the work started represented an operation that under normal freight conditions would have taken from ten days to two weeks. The work at the refinery was a cooperative effort, with typists, laboratory employes, operators and guards pitching into the job of salvage.

CURED IN THREE WEEKS

Three weeks after the hurricane roared away, the completely rebuilt tower was on the job

Free Enterprise

WHAT IS IT? HOW DOES IT WORK?

☆

OURS is a free-enterprise economy the chief motivating forces of which are the prospective rewards for effort and risk-taking. Its smooth operation depends: first, on adequate incentives for risk-taking, innovation, and individual effort; and second, on sufficient competition to minimize the need for government regulation and to prevent artificially high prices or wages from being maintained in large segments of the economy. Trouble comes when these incentives and this competition are tampered with or removed.

America was founded by men who had the urge to better themselves and the courage to take a chance. These men uprooted themselves in Europe and braved the unknown. They risked all for freedom. They knew that, to be free, they had to attain economic freedom. Their goal was an economic freedom which permits the private ownership of property, the free choice of jobs, and free entry into entrepreneurial pursuits. Their efforts, therefore, were directed toward individual opportunity with no limit on individual achievement. Their foresight and the endeavors of those who followed them created the world's greatest industrial nation enjoying the highest standards of living.

We can take pride in the knowledge that our country has been the greatest single contributor to the world's physical assets even though we remember that an abundance of natural resources contributed materially to America's economic development. But the fact that our progress has been interrupted, again and again, by depressions which resulted in enormous wastes of our human and material resources is sobering proof that our economic mechanism still is far from perfect.

Our production per man-hour has been increasing at the rate of 2½% per year. Improved machines and greater efficiency have more than tripled the output per hour of work since 1900. Looking to the future, this annual rise indicates that our production per hour of work will double in the course of the next 25 to 30 years. This means that we can have twice our present volume of goods and services per capita or an equivalent combination of more production and more leisure. In other words, we can further increase the living standards and further decrease the working hours of the American people by further intensifying our industrial efficiency.

This is no idle dream. It can be achieved, and it will be achieved, if only we maintain the essential features of our system of individual enterprise which alone makes possible this near-utopian goal. Intensification of our efficiency, however, means that we can have full employment only if we expand enormously our production, and particularly our production of new goods. We can expand total production only if we have the markets and the demands for the vast output of goods and services made possible by our technological development. To attain these, we will need to venture into new markets, new inventions, and new methods. Such ventures involve risks, and risks will be taken only if there is sufficient prospect of reward.

Let us never lose sight of the fact that the essential features of free enterprise are the prospective rewards for risk-taking as well as for effort.

The evidence is clear that incentive methods of wage payments will boost production. Carefully devised systems of salary payment with large differential inducements for superior performance have been powerful means of raising the standards of managerial accomplishment.

Free enterprise cannot operate effectively unless the wage and salary system offers greater rewards for greater effort. Neither can it operate effectively unless the prospects for profit are sufficient to encourage the employment of resources which otherwise would be kept idle.

Unless the prospects of profit are superior to the prospects of loss, new ventures will not be undertaken and going concerns will not expand or continue long in business. When the hope for profits wanes, employment and production slump; when that hope revives, employment and production recover.

Business initiative must be given every possible in-

ducement in order that maximum employment may be achieved through private enterprise. This involves the removal and avoidance of restrictions on business by government, by labor, and by business itself.

Competition is the life-blood of the free enterprise system. Business and industry must rely upon efficiency rather than upon protection from competition for their survival.

Those government controls which were made necessary during the war by the magnitude of government demands for goods should be lifted at the earliest possible moment. As soon as the danger of inflation has receded, price controls must be removed and profit margins again left free to be determined by market forces. The excess profits tax must be repealed and the burden of other taxes on business profits greatly reduced. Tax laws should be revised so as to permit adequate rewards for assuming risks. The modernizing of anti-trust laws and their vigorous enforcement, not indiscriminate persecution, will be supported by all who really want free enterprise. Such measures will strengthen the incentives to expand old businesses and to start new ventures.

Grants of unlimited monopoly powers to labor unions which enable them, consciously or not, to sabotage the profit incentive in business must be withdrawn. Labor has certain legitimate rights; and in order to preserve them and its freedom, labor must come to realize that its best interests lie in a well functioning, self-disciplined competitive free-enterprise economy.

There must be evolved in the minds of business, labor, and the public a recognition of the need for private business enterprise and a realization that policies which throttle it are harmful not only to businessmen but to workers and consumers as well. Unless we achieve this understanding and avoid needless deterrents to business expansion, we are likely to pay for our folly in the destruction of our free enterprise system.

We cannot tolerate conditions in which special interest groups in business, labor, agriculture, or politics prevent free access to the market by would-be competitors. Such monopolizing of opportunities stifles progress and creates profits or wage rates based on artificial scarcity. In such cases government interference to open the market to all comers is clearly indicated. We must recognize the need for constructive policies by business, labor, and government which will insure the competition necessary for the successful operation of our economy.

Increased government regulation and control of business activities is not conducive to strengthening the virility of private enterprise. Government ownership and operation of productive resources certainly is not to be condoned. The more government rules and regulates business, the less will be the incentive to assume risks and to exercise individual initiative. Government regulation of the detailed operation of industry inhibits progress, is prey to political pressures, and is subject to the human failings of its administrators. *Better far the rough guidance and justice of vigorous, though somewhat imperfect, competition than the uncertainty of arbitrary regulation.*

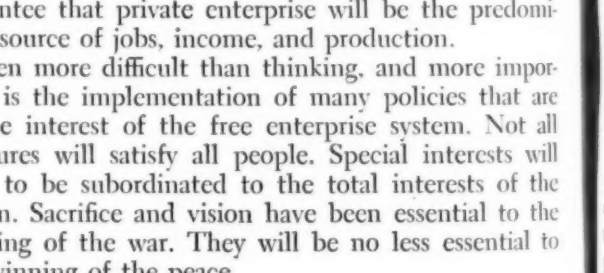
The gravest threats to our competitive system exist in legalized monopolies, such as the N.R.A. once comprised, such as the labor unions and farm groups have recently achieved, such as businessmen themselves have sometimes sought. The power of labor monopolies to encroach on business profits will tend to interfere seriously with the needed flow of new investment. And when any group is strong enough to move the average level of costs as much as the labor groups and the farm groups are able to do, there is good reason to fear that, when we begin to approach high levels of employment and production in time of peace, these groups will induce a price-wage spiral which will waste money incomes on price increases instead of permitting them to draw unemployed resources into production. While the demands of labor for collective bargaining rights and the demands of farmers for protection against the rigors of depression have validity, there can be no reason for excessive grants of power and privilege which threaten to make our system of free enterprise unworkable.

Ours is a complex economic structure. The functions which prices, income, savings, investments, and taxes play in this system are difficult to comprehend.

As I have said before: Thinking is hard work, and we will have to work hard if we are to develop business policies, labor policies, and government policies which will insure full employment and the opportunity for consistent profit. Yet only through such policies can we guarantee that private enterprise will be the predominant source of jobs, income, and production.

Even more difficult than thinking, and more important, is the implementation of many policies that are in the interest of the free enterprise system. Not all measures will satisfy all people. Special interests will have to be subordinated to the total interests of the nation. Sacrifice and vision have been essential to the winning of the war. They will be no less essential to the winning of the peace.

If we can gain recognition of the crucial role of incentives for enterprise, if we stand squarely for competition and against protection or privilege for special interests, and if we bend our efforts to find satisfactory ways and means to prevent large-scale unemployment, we can have the full benefits which only a free enterprise system can produce—in industrial progress, in improved standards of living, and in the preservation of our democratic ways of life.



President, McGraw-Hill Publishing Company, Inc.

Too Low A Head Pressure Can Cost Money

Using an abundance of expensive cooling water to reduce compressor load sometimes results in upping over-all costs. A B Duryee explains how water cost can increase faster than power cost drops

▸ REFRIGERATING PLANTS equipped with evaporative condensers or cooling towers usually require but little makeup water. However, many others use shell-and-tube or double-pipe condensers and discharge the cooling water to waste. Since this requires 100% makeup, water costs become an appreciable item.

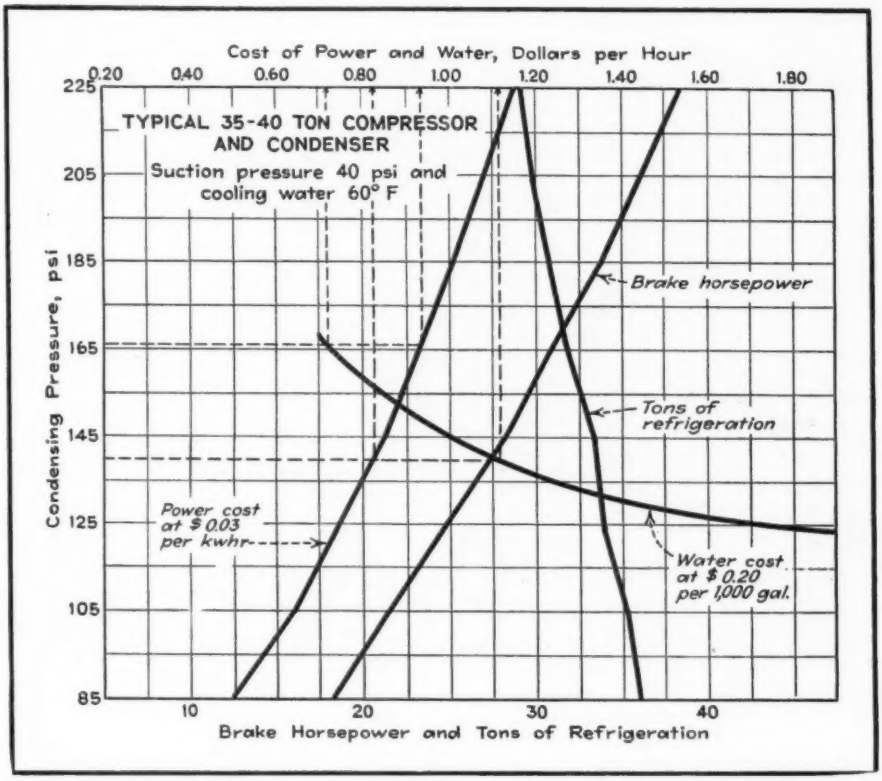
Many engineers hesitate to reduce water flow through the condensers because head pressure rises and power consumption increases. In most instances cost of the increased power is far less than that of the water saved. Of course, there are exceptions where power costs are extremely high and water costs low. The average plant pays about 3 cents per kwhr for power, and 20 cents per 1,000 gal of water.

The curves, based on a constant suction pressure of 40 psi and condensing water temperature of 60 F, show relative costs of these two items on a typical 35-40-ton compressor and condenser. Conditions, of course, vary with each plant, but we are interested primarily in keeping total power and water cost as low as possible.

Let us assume we reduce condenser water flow until head pressure is constant at 166 psi. Water required to maintain this pressure costs 72 cents per hr and power 93 cents, or a total of $1.65 per hr. Now, suppose we increase the water flow until the head pressure drops to 140 psi. Water then costs $1.10 per hr and power 83 cents, a total of $1.93 per hr. It is evident that when power and water costs are anything like the foregoing it pays to cut down on water.

This does not mean that extremely high head pressures should be carried. Machines heat up and wear out more rapidly when pushed to the limit and refrigerant leaks develop that are not in evidence at lower pressures. Emergencies often arise, however, when it is important to continue refrigeration, and economy becomes secondary.

For example, let us assume we are operating an ice-making plant that sends ice out as fast as it is made. Half the cans have just been filled, preparatory to freezing; the remainder are about half frozen. Then, electrical trouble develops, making it necessary to shut down the compressors for several hours.



Draw curves similar to these using local water and power costs to determine most economical balance between head pressure and cooling-water flow at condenser

First step would be to shut down the brine circulator and save the ice already made. If the circulator continues to run, the brine picks up heat from the freshly filled cans and melts the partially frozen ones. With it shut down, the brine adjacent to the freshly filled cans heats up but, if not disturbed, the main body of brine receives heat slowly.

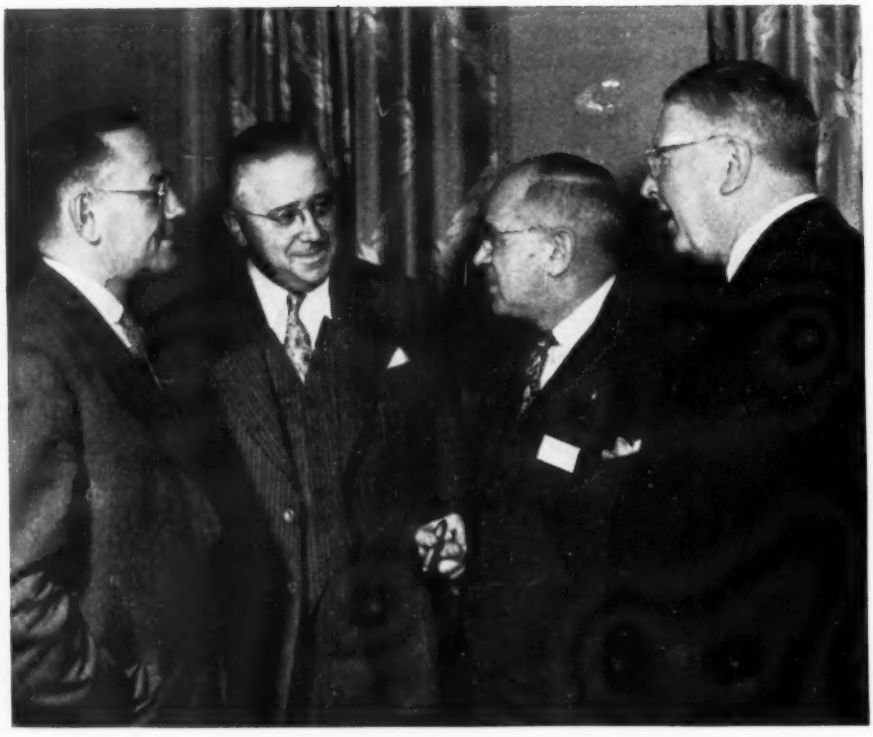
Gaining Lost Time

Having made repairs, we start the compressors. If they operate at constant speed there is not much we can do to regain the lost time. However, every little bit helps. Suction pressure will be high and head pressure will start to rise. Since we are interested in getting a maximum amount of work out of the compressors we reduce the head pressure as much as circumstances permit. It may pay to use considerable water if it holds the head pressure down until the brine temperature reaches normal.

When condensing-water temperature is high and head pressure rises to the cutting-out point, even with a full supply of water going over the condensers, the safest thing is to throttle the suction valves or reduce the quantity of liquid refrigerant going to the brine cooler.

Some operators, whose plants are equipped with electrical high-pressure cutouts, make it a practice to block the cutout to keep the compressor running. This is dangerous unless they watch the head pressure gage constantly. There is not much danger of damaging the compressor (most ammonia compressors, especially the more modern ones, can operate at pressures up to 300 psi), but piping and fittings may not be able to withstand the high pressure. Don't tamper with safety devices. Keep them functioning properly.

Iron and Steel Engineers Discuss Many Power-Production Problems



Left to right, radiating confidence for the steel industry's future: J T Whiting, director, steel division, War Production Board; J A Clauss, chief of plant facilities branch, War Production Board; Frank E Flynn, district manager, Republic Steel Corp and 1943 president, Association of Iron and Steel Engineers; and Wilfred Sykes, president, Inland Steel Co. Photo taken before the annual dinner, Sept 30, which nearly 1200 steel and power engineers attended. Mr Sykes and Mr Whiting were the speakers and presented some of the present and future phases of the steel industry

On opposite page, C L McGranahan, assistant general superintendent, Jones & Laughlin Steel Corp, elected president AISE, 1944

Extreme right—It is units like this 15,000-kva tap-changer electric-arc-furnace transformer that are helping to produce over 5,000,000 tons of electric steel this year, as mentioned by C C Levy, Westinghouse Co, in his paper, "Methods and Equipment for Supplying Power to Steel-Melting Furnaces"

▶ DISPLAYING AN UNRELENTING VIGOR and energy characteristic of the steel industry, the Association of Iron and Steel Engineers held its annual convention and engineering conference at the William Penn Hotel, Pittsburgh, Pa. Thirteen technical sessions were crowded into three days, Sept. 28 to 30. At these sessions, attended by over 2000 engineers interested in iron- and steel-mill operation, power generation and associated problems, 35 papers were presented and discussed.

Boiler-plant operation: "Feedwater Treatment for Weirton's High-Pressure Station," presented by J H Strassburger, manager of maintenance and service, Weirton Steel Co, Weirton, W. Va., is of particular interest to power engineers, because of the record for operating continuity by plant boilers and turbines. This high-pressure topping plant contains three boilers, continuously rated 315,000 lb of steam per hour at 850 psi and 820 F and two 10,000-kw 3600-rpm turbines.

Two boilers and one turbine began operation in 1936 and one boiler and turbine went in service in 1940. The turbines exhaust to an older plant, containing five 7500-kw turbines operating at 215 psi and 400 F and exhausting to barometric condensers, so that the boilers use 100% makeup feedwater. The first two high-pressure boilers and one turbine were described in POWER, July 1937, page 370. These boilers replaced 35 old low-pressure ones and cut plant coal consumption 180,000 tons per year.

Feedwater Treatment

In his paper, Mr. Strassburger said that when the high-pressure plant was designed, 850-psi was selected as the most desirable steam pressure in the light of experience with high-pressure boilers operating on 100% makeup. Feedwater from the Ohio River is first chemically treated by a lime-soda hot process. Leaving the hot-process tanks, the feedwater is filtered and pumped to a deaerating heater from which it goes to storage tanks above the suction of the boiler-feed pumps. Phosphate feedwater treatment was originally applied at the feed-pump suction but is now injected continuously into the boiler mud drums. The latter produces better results with a reduction in amount of phosphate.

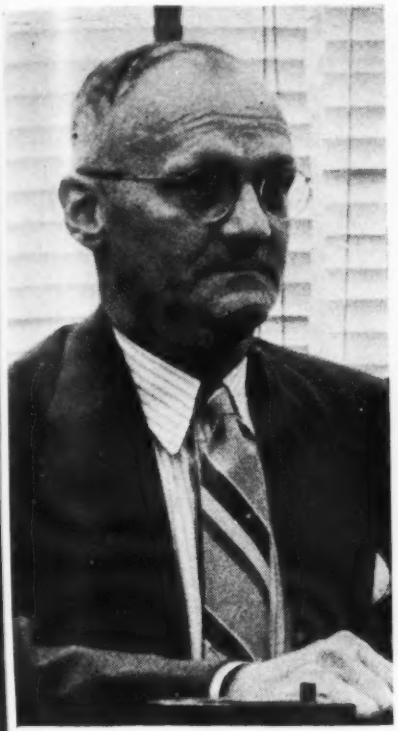
Feedwater enters the boiler steam drums through the steam-washer nozzles. To determine the effectiveness of spray nozzles in steam washers, the third boiler was installed without these nozzles. It was found that, because of fouling of the turbine blades, the turbine supplied from this boiler lost capacity faster than the other unit. This showed that the nozzles assisted in cleaning the steam and they have since been installed in the third boiler.

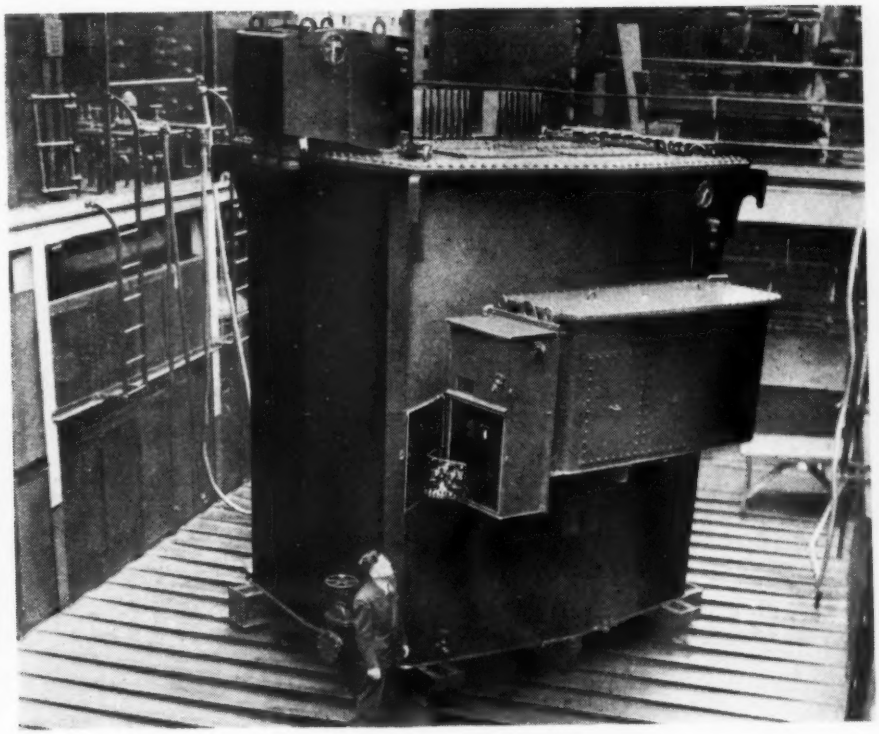
The boilers are operated with a continuous blowdown of 10 to 11%, and feedwater samples are taken from the boilers every two hours and tested. Two boilers operate continuously. When one goes in service it operates 100 days before being taken out for inspection and cleaning. This requires about four days, the largest part of the time being required for work outside the boiler. Inside, only light deposits are found which are easily cleaned out.

Availability Record

When the turbines begin to lose capacity because of their blades fouling, they are washed out with low-pressure steam and water while they rotate at low speed. This plant has generated nearly 600,000,000 kwhr during seven

For three days over 2000 iron and steel engineers ponder problems of feedwater treatment, power-plant operation, combustion, fuel supply, electric-power distribution and application, fire protection, safety and other subjects associated with producing over 90,000,000 tons of steel in 1943





years, with an annual availability factor for the boilers and turbines of 96 to nearly 99%.

In this enviable record, supervision and control feedwater treatment has been one of the most important factors. Mr. Strassburger said that experience had shown that the higher-pressure topping plant using 100% makeup feedwater was little more difficult to operate than the 225-lb plant.

L S Wilcoxson, Babcock & Wilcox Co, in his paper "Pulverized Fuel for Metallurgical Furnaces," expressed the opinion that fuel-oil costs would rise and that engineers must give attention to substituting coal for oil fuel where economically possible. Mr. Wilcoxson described several metallurgical furnaces in which pulverized coal was burned instead of oil or gas.

Oil and coal: In "Colloidal Fuel as a War and Postwar Liquid Fuel," J G Coutant said that during the next 5 to 15 years we would have to find a substitute for fuel oil and suggested colloidal oil. This fuel consists of 60% oil and 40% coal, processed in a colloidal mill until it goes through a 450-mesh screen.

It can be transported and stored the same as fuel oil and burned in existing oil-burning equipment. The coal and oil are so intimately associated that the coal does not settle out of the liquid, at least for a long time. A 50-50 mixture of coal and oil has been tried but required a special burner. Experiments with this fuel by the U. S. Bureau of Mines and Atlantic Refinery Co were described in August, 1943 POWER, page 72.

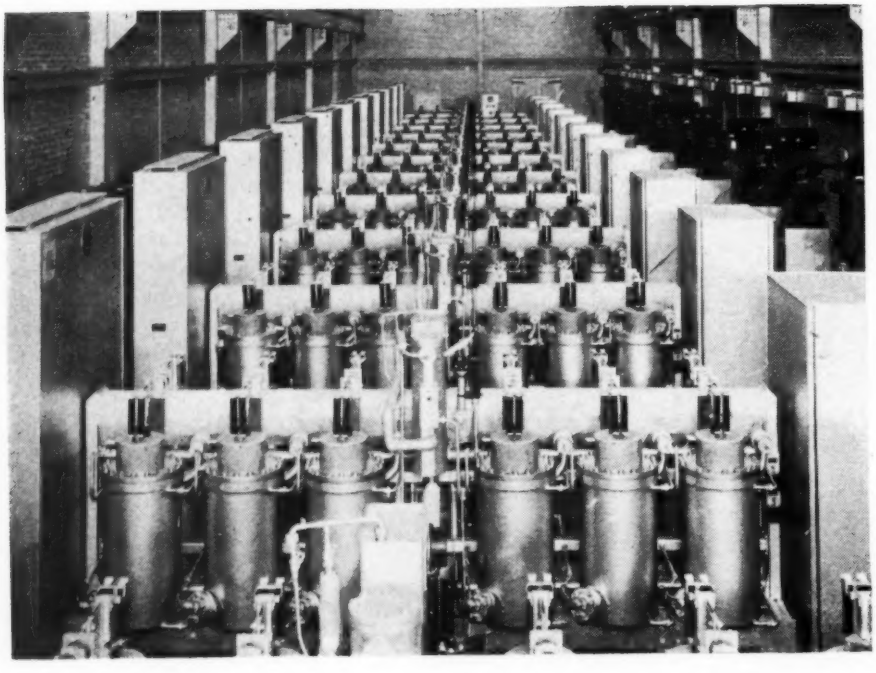
Fire Protection

High-pressure and low-pressure CO_2 fire-protection systems were compared by C A Getz, Cardox Corp. The high-pressure systems are built around 5.5 to 50-lb. uninsulated cylinder of CO_2 under a pressure of 1800 to 2000 psi. In the low-pressure system, liquid CO_2 is stored in a single heat-insulated container at 300 psi and 0-F temperature. These containers range in capacity from 500 lb to 125 tons and are equipped with a refrigerating system to maintain the CO_2 temperature around 0-F automatically. The systems also have automatic protection that keeps pressure within 340 psi should the refrigerating system fail.

Mr Getz said the low-pressure low-temperature system enhances the fire-extinguishing properties of CO_2 by increasing the dry-ice snow yield, extends its reach in direct application work and gives a uniform rate of discharge.

Robots for manpower: Defining a robot as any automatic apparatus or device that performs functions ordinarily carried on by human beings, or that operates with what appears to be almost human intelligence, F Mohler, General Electric Co, proceeded to establish a yardstick by which to measure the manpower saved by such devices. He said that from the beginning of construction of any apparatus to its installation, time of many individuals is involved. This includes the time spent by commercial engineers, application engineers, designing engineers, draftsmen, clerks, accountants, planners, machinists, assemblymen, test men and field engineers, in addition to all those involved in producing the raw material. It is obvious that the relative man-hours spent by these various individuals with respect to the cost of a particular piece of equipment varies with its class and type. However, said Mr Mohler, as a yardstick you may

(*Continued on page* 158)



Twelve six-unit ignitron mercury-arc rectifiers installed in a large electro-chemical plant, each rated 5000 amp., 645 v, or 3225 kw when converting ac to dc

Electron Tubes Broaden Electric-Power Applications

Experts tell of the many jobs industrial electronics are doing in power rectifying, frequency changing, motor control, measurement and testing, welding, heating and other fields

▶ INDUSTRIAL ELECTRONIC equipment plays an indispensable role in America's record-breaking war production. A comparative newcomer to industrial plants, major developments having taken place since World War I, this tool has been directly responsible for saving millions of man- and machine-hours and millions of pounds of critical material since Pearl Harbor, according to General Electric officials speaking at a conference on industrial electronics, held in Schenectady, N. Y., Sept. 14.

In pointing out how electronics have already come to maturity in industrial operations, L A Umansky called attention to the fact that 1943 will see 25 billion kilowatt-hours of electrical energy passing through electronic devices. No one familiar with industrial engineering, he said, considers any longer as a daring or pioneering feat the use of electron tubes for accurately controlling motor speed or acceleration; for precision-positioning a sheet of paper on a printing press; for color matching; for controlling wire tension; for detecting smoke; for controlling temperature—to mention a few of the hundreds of electronic applications that have passed from the laboratory to the factory stage.

Electron Tubes

In describing the variety and versatility of modern electron tubes, W C White stated that tubes are available that detect and measure currents of far less than a billionth of an ampere. Others carry thousands of amperes. Similarly, a millionth of a volt can be detected and amplified, and voltages up to one hundred thousand rectified. On the frequency scale, tubes are available to provide frequencies up to about a billion cycles. Physically, some tubes are so small that they fit into a thimble, others are bigger than a man.

Electronics as applied to power conversion, means changing ac power to dc, explained L W Morton. Mercury-arc rectifiers, used predominantly for this purpose, have recently expedited production of light metals in two ways: (1) If the 2,500,000 kw of dc power required to produce aluminum and magnesium had to be supplied by rotating machinery instead of by mercury-arc rectifiers, this program would probably have been delayed for several months. (2) Since rotating conversion apparatus requires, roughly, for the same output capacity, 50 to 100% more steel and 25 to 75% more copper than electronic rectifiers, it is estimated that 40,000,000 lb of steel and 3,750,000 lb of copper have been saved for other vital industrial purposes.

Mr Morton pointed out that the same principles used in converting power from ac to dc could be slightly modified to convert dc to ac. Early this fall General Electric is placing in service an electronic frequency changer rated 20,000 kw, which will connect a large steel company's 25-cycle power system to the local power company's 60-cycle system. The apparatus will be able to deliver constantly any desired kilowatt rate within the 20,000-kw rating from either system to the other.

Electronic Measurements

W C Hutchins told about the new electronic winding-insulation tester which is helping to make better motors. A sound-level meter, utilizing a specially designed microphone in combination with an electronic circuit, makes it possible to convert minute sound-pressure waves to an accurate, numerical value.

"The science of electronics," said Mr Hutchins, "has enabled the engineer to build equipment that is almost human in that he has practically duplicated four of the human senses. To illustrate, the mercury-vapor detector simulates the sense of smell; the sound-level meter the sense of hearing; the vibration meter the sense of touch; the photoelectric tube the sense of sight, even to the extent of distinguishing colors more accurately than is possible with the human eye."

Electronic Heating

Electronic heating, J P Jordon pointed out, covers the application of high-frequency vacuum-tube oscillators to two broad fields; the induction heating of metals and the dielectric heating of non-metallic materials such as ply-

(*Continued on page* 144)

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

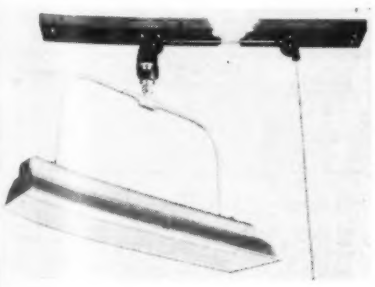
PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Spotting Fluorescent Lamp Troubles

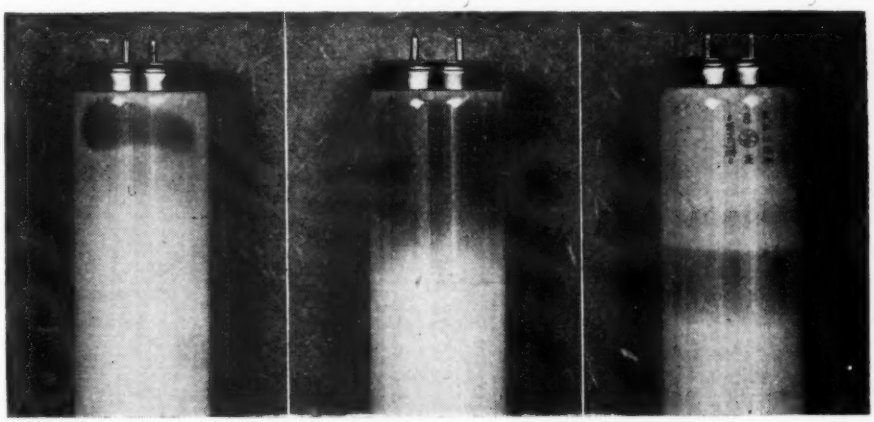
These essential maintenance pointers give the trouble-shooting information you need to cut down expensive lamp damage, keep lamps shipshape and ready to deliver a maximum amount of light when they are turned on

HERE are the reasons for prompt, careful attention to the small amount of maintenance that fluorescent lamps require: (1) Fixture purchase and installation involve considerable investment of time and money. (2) War needs make materials for many parts scarce and, therefore, difficult to buy unless you have an extremely high priority rating; in addition, cost of parts is comparatively high now. (3) Proper care insures better light output, resulting in less eyestrain and fatigue.

When something goes wrong with a lamp, auxiliary or fixture, *turn it off immediately*. Advertise this fact throughout the plant. Some defects put an abnormal load on lamps, ballasts and starters. Turning the fixture off when trouble pops saves burned-out starters, ballasts, ruined equipment.



In many instances it is more convenient to install fluorescent fixtures on pulleys for raising and lowering



End-blackening causes: left, mercury deposit; center, overvoltage or defective equipment; right, normal end of electrode or fluorescent-powder life

Lamps may blink, flicker, spiral or smoke; and fixtures may hum and even smell. (See Data Sheet, page 138, for additional troubles.) Some of these are normal developments; others result from one or more causes. Let's look at certain indications, plus a few experimental tests, that tell where the trouble lies.

Some troubles result from more than one cause. Accordingly, when testing defective or damaged equipment practice maintenance economy by trying the simple, least expensive remedies first. For example, if a lamp flickers for some time, it may be the fault of voltage, ambient temperature, tube, starter or ballast. Therefore, check voltage and ambient temperature and look for cold drafts striking the lamp; sometimes a lamp won't light because a starter has worked loose from the socket. Making such a checkup first may save the cost of a lamp or starter.

Spare Stock

If at all possible, keep a few lamps, ballasts and starters on hand for emergencies. They help to make quick checks right in the fixture, to determine which element is at fault. Difficulty in obtaining replacements dictates the number of extra units to keep on hand.

Here are some trouble-shooting tests:

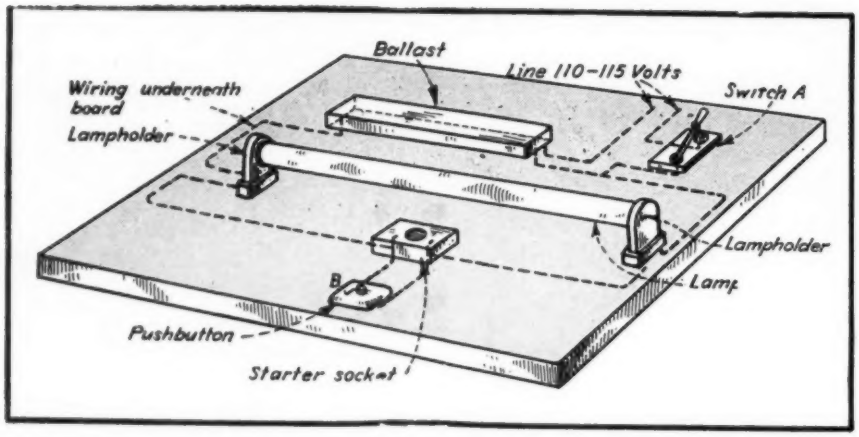


Fig. 1—Board, for testing lamps and starters before putting them in the fixture, should also be used for testing lamps and starters before discarding them

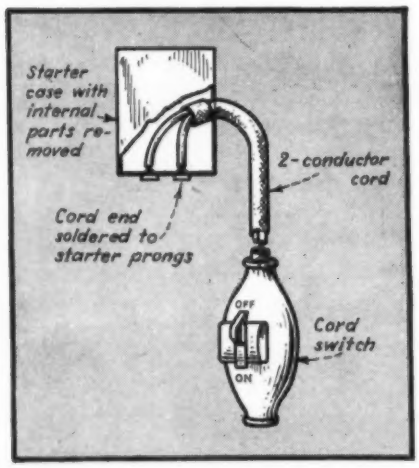


Fig. 2—This manual starter, made from an old starter switch, helps in testing lamps, starters and auxiliaries without taking the lamp fixture apart

Broken cathodes or air leaks in a lamp: Test each end of the lamp separately by connecting the two base pins in series with a 60-watt 115-v filament lamp on a 115-v circuit. If cathodes are intact, the lamp filament lights and the fluorescent bulb end glows. Absence of glow indicates a burned-out cathode or air leak. Use a 60-watt filament test lamp for fluorescent lamps of 14-40 watts; for 65- and 100-watt fluorescents use a 200-watt 115-v test lamp. Commercial cathode testers are available.

A test board, Fig. 1, helps greatly in checking starters and lamps on the job, but, of course, it does not show up wiring or ballast troubles. Be sure test conditions, such as voltage and ambient temperature, are the same as those existing at the permanent fixture. Always test a lamp or starter on the test board before installing or discarding it.

Using the test board: Place bulb in holders so that base pins make good contact and close switch *A*. Then push button *B* and hold it down several seconds. A good lamp lights immediately when pressure on button *B* is released.

To test a starter put a good lamp in the lampholders. (Test it as above.) With switch *A* open, insert starter in socket and close switch. If starter is good, lamp lights and operates continually. If lamp ends glow continually, but lamp does not light, starter contacts are stuck. Absence of end glow shows that starter contacts have not closed; this defect in a glow starter indicates that breakdown voltage is too high. Test-board voltage should never be less than 110 v.

A manual starter, Fig. 2, checks starters and lamps while they are in a fixture. When trouble symptoms appear, remove lamp's starter and insert manual starter. With cord switch in "on" position, ends of bulb should glow; if no glow appears, insert a new tested tube. If the ends of this unit do not glow with switch in same position, lamp holders, wiring or ballast is defective. When lamp ends glow with switch "on," a good lamp starts when switch is opened. If it doesn't, snap the switch several times before condemning the bulb. When it lights properly with manual switch but does not with old starter, trouble is in this element.

Clean the Lamps

In addition to testing and replacing lamp parts when they are defective, keep reflectors clean. This alone increases light output as much as 50%. To clean porcelain or synthetic-enameled reflectors, remove lamp, then wash reflectors with soap and water and rinse with clean water. Don't dry-wipe because part of the dirt will remain on the reflector. Wash lamp tubes thoroughly, especially if the fixtures are in a dirty atmosphere. Don't use either a strong alkaline or acid solution on aluminum reflectors.

Hum, generated by magnetic forces within the transformer, may be objectionable in certain locations. If the lamps are in a room with noisy machinery, obviously it doesn't matter, but in quiet rooms the hum disturbs occupants. Manufacturers design and assemble ballasts to minimize this hum, but sometimes a fixture is noisy. If it is, take these precautions: (1) Check ballast mounting; attach it to a rigid part of the fixture. (2) Fasten all metallic parts securely because loose screws or bolts amplify hum. If excessive noise persists and can be traced to a defective ballast, replace it.

For assistance and material in preparing this article, POWER is indebted to Charles Amick, author, "Fluorescent Lighting Manual"; and literature published by several fluorescent lamp manufacturers.

FLUORESCENT LAMP RECORD

LAMPS						STARTERS						BALLASTS					
Originally Installed			Replaced			Originally Installed			Replaced			Originally Installed			Replaced		
Date	Number	Cost	Date	Number	Cost	Date	Number	Cost	Date	Number	Cost	Date	Number	Cost	Date	Number	Cost
Total																	

Use this record sheet to keep track of number and cost of equipment replacements. It also serves as a check on lamp life

REFRIGERATION NOTEBOOK — 8

Know-How of Choosing Air-Conditioning Systems

By TERRY MITCHELL, ME, *Frick Company*

A study of air conditioning, begun in October, is concluded here.—Editor

Controlled air volume: Office buildings, where cooling load includes removal of but little moisture, are regulated by varying the conditioned-air volume some 30% as it leaves the main fan.

Fresh air and recirculated air are proportioned by hand-set dampers in the inlet ducts. (This also applies to the two systems described below.) All the air passes through the filters and cooling coils: a thermostat starts and stops the compressor. As the humidity rises a humidistat partially closes the automatic fan-outlet damper, cooling less air through a wider range. The moisture content is more accurately controlled (than is possible by thermostat alone) simply and automatically; the system is comparatively inexpensive to install and needs little attention.

Automatic bypass system: This is recommended for loads having high latent heat, as where quantities of water vapor are given off in process work, or there are large groups of people. (See diagram in October POWER.)

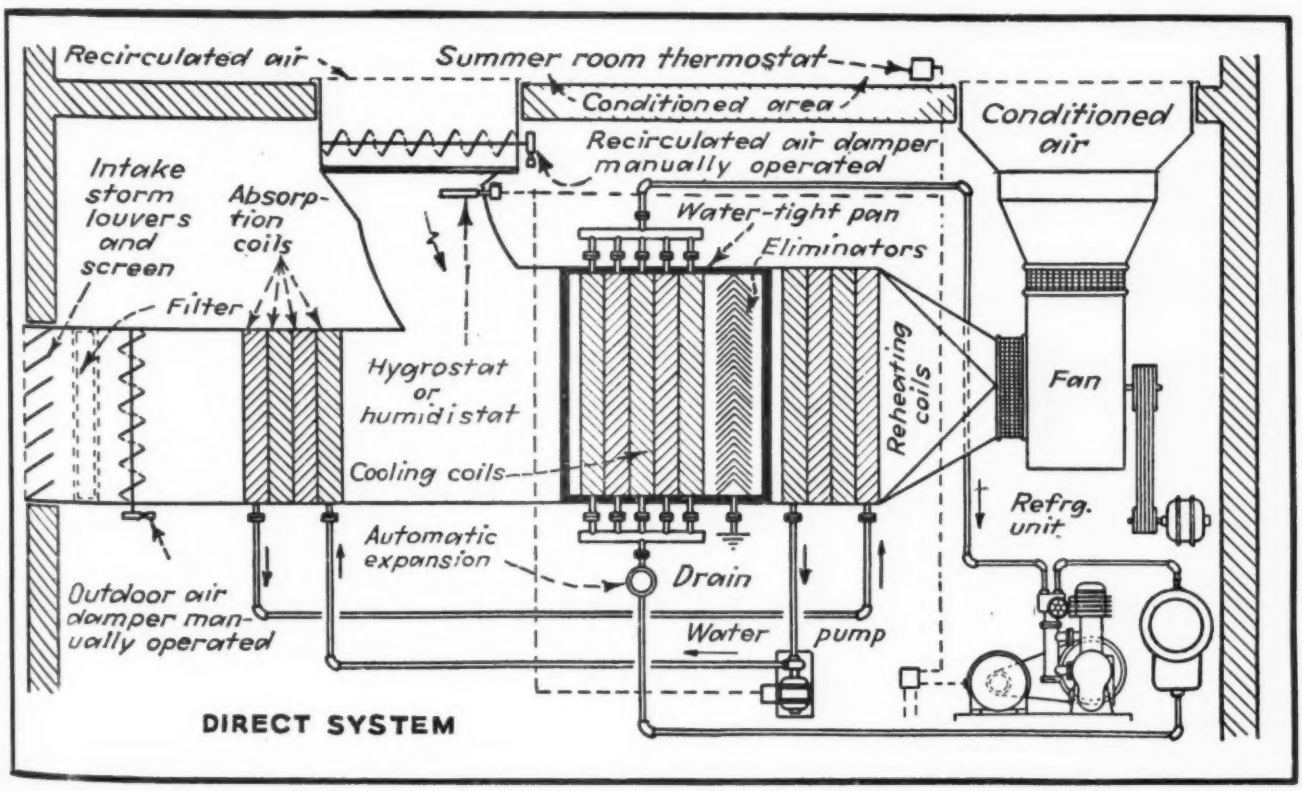
A modulating thermostat in the conditioned space controls a modulating motor on the bypass damper as the temperature changes: the amount of air passed through the cooling coil can be varied up to 60%. The total air volume handled remains constant, which simplifies distribution for many small rooms.

An auxiliary switch on the motor-operated damper starts the compressor when the bypass damper is closed, and stops the machine when the damper is opened wide. A dewpoint thermostat can be wired in series with the auxiliary switch, to keep the compressor shut down as long as the dewpoint is low enough to give the humidity wanted; this saves refrigeration. The entire bypass arrangement is patented, and widely used.

Direct system: This is of special use where load is high for amount of air circulated, and there is much latent heat. Rooms with low ceilings and a heavy moisture content are most satisfactorily conditioned by the direct system, which also commends itself wherever the ultimate in comfort is desired.

The air volume handled is constant, and all of it goes through the cooling coils. If the resulting temperature is too low it is raised as needed by the reheating coils which pick up heat from the incoming fresh air. A thermostat controls the compressor; a humidistat controls the reheating water pump.

The accurate control made possible can hardly be duplicated in any other system. Properly dehumidified air can be supplied at dry-bulb temperature within 3 F of that of the recirculated air, or within 6 F of the outside dry-bulb, whichever is higher. The direct system prevents unduly low temperatures when air must be dried by cooling. It costs more, but for heavy and varying loads it is worth the difference.



Heat removed from incoming air goes to regulate temperature of cooled air after its moisture content has been reduced

PRACTICAL AIDS TO OPERATION

Gasket Pad on Hand Speeds Cement Job

WHEN INSULATING PIPING, especially the smaller sizes, it is a slow tedious job applying asbestos cement with a small trowel. To speed up this job I cut a piece of sheet-rubber gasket big enough to cover my hand. By trial you can vary the size and shape until you get one that best suits you. Cut a hole for your thumb and use the pad on your hand for a trowel, as in the photo, to put the cement over the asbestos covering.

Your thumb through the hole anchors the pad to your hand and it can be bent to conform to the pipe's shape. You will find that the job can be done neater, quicker and easier than with a trowel.

Tacoma, Wash. K M WHITE

Chrome Plating Extends Pump-Liner Life

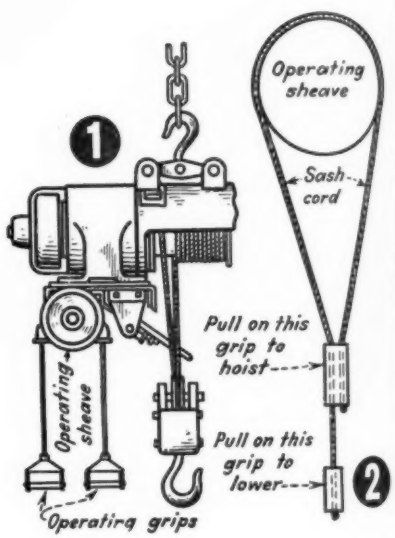
WE HAVE SEVERAL DUPLEX PUMPS, two of which are in constant use on boiler-feed service handling 210 F water. Because of the high silica content in the feedwater (we have no filter), pump cylinder liners had to be replaced about every ten months. Three months' service would score a set of liners and the pistons would have to be repacked. The scoring kept getting worse until the packing would last only three weeks. This was quite an expense, besides wasting material and labor.

We made frequent inquiries about ways to eliminate this trouble, but without results. One day we talked over the problem with the owner of a large machine shop and decided to try chrome plating. We polished the inside of the 5½ × 13½-in. liners, made of Hitensl bronze, to a mirrorlike finish. We then plated the surfaces with 600-Brinell-hardness chrome to a 0.003-in. thickness, and polished them to a high, glossy finish at a total cost of $6.00 for plating each liner.

Liners in the first pump, which has been running almost constantly for over two years, were plated in July 1941. They are in as good condition as when they were installed, and the pistons have not been repacked during that time. We chrome-plated the liners in the second pump with equally good results three months after those in the first pump. No wear has occurred on either liners or packing.

We also eliminated a lot of valve trouble. Pieces of packing used to get in and wind around the valve seat and cause leaky valves. Pieces of packing also went through the feed line and into the feedwater regulator, causing more trouble. We are now considering chrome-plating liners and rods of all our pumps as this saving of material and labor pays large dividends. Our liner and packing maintenance has been reduced from about $230 per year per pump to a small fraction of this amount, and we anticipate many years' service from the chrome-plated liners.

Elmhurst, Ill. WILLIAM MEINECKE



Makes Two-Handed Control One-Handed

GENERALLY small electric hoists are controlled by two hand ropes: one for up and one for down direction, as in Fig. 1. To control the hoist rapidly may require two hands, and even under normal operation it is not convenient to shift from one control cable to the other, when using only one hand to control the hoist. I solved this problem in our plant as in Fig 2. One end of the control cable connects to the upper wood grip. Other end of the cable goes through this grip in a clearance hole and connects to the lower grip. This is a very simple trick that has simplified the operation of our hoists.

Hoisting and lowering grips are now always together. When lowering a load,

the hoisting grip can be brought into use quickly by simply releasing the lowering grip and moving the hand up to the hoisting grip. This arrangement works well and the men like it.

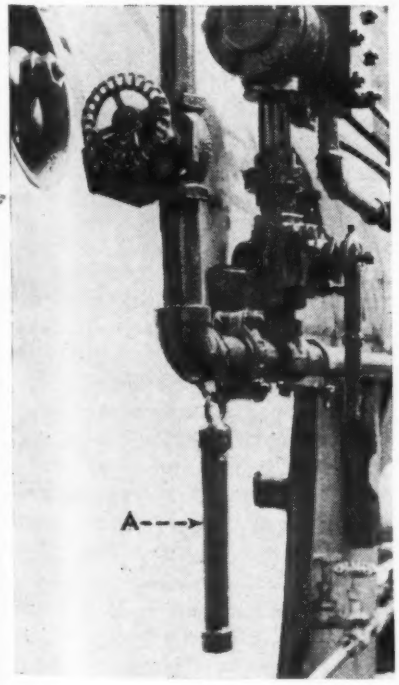
Cleveland, O. WM VON BENKEN

Pipe Capsule Protects Boiler Certificate

BOILER-CODE LAWS REQUIRE that each boiler's inspection certificate be available at all times on the site of the installation, but sometimes the certificate becomes torn, weatherworn or even lost. Some boilermen insert the certificate in a picture frame, but often this proves too fragile and is broken because of the hazardous conditions.

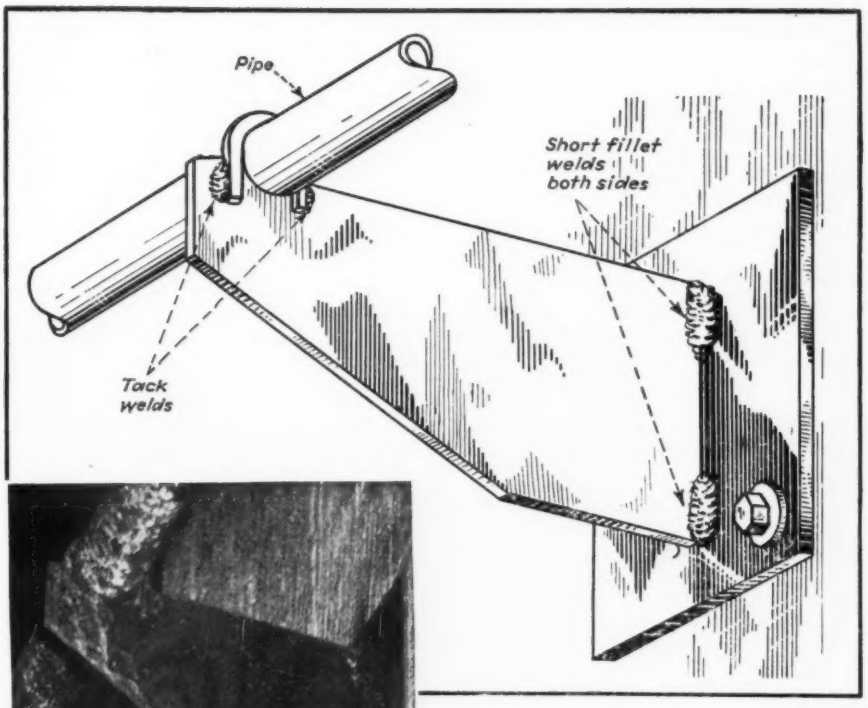
The plant superintendent of one company operating a number of boilers adopted the practical and inexpensive method of inclosing the certificate for each boiler in a 1-in. pipe nipple 10 in. long, sealed with a pipe cap on each end. A ring welded to the cap on its upper end permits the capsule to be suspended from any convenient part of the boiler such as from a pipe, as at *A* in the photo.

Before using the nipple, the interior is thoroughly cleaned and all burrs and



rough spots removed. Sealing the bottom cap with thread dope and screwing the top fairly tight, makes the receptacle safe, dependable, and weatherproof. This idea is particularly applicable to outside boilers with little or no protection from the weather.

Pomona, Calif. G M WILSON



Simple Welded Bracket Suspends Piping

A SIMPLE ARC-WELDED BRACKET, shown in the photo, for suspending various lengths and sizes of pipe was described by one of our plant maintenance engineers. Its simple design permits fast installation of piping and saves critical material.

The bracket is made of two pieces of ⅛-in. steel plate cut to shape as the diagram shows. To complete the bracket its tapered section is placed at right angles against the square plate and fillet welded on both sides, top and bottom. These brackets are bolted to concrete columns or side walls of the plant. After the pipe has been placed into the half-round cut in the bracket, a length of ⅛-in. round steel bar is formed around the pipe and tack welded to the bracket to hold the pipe securely in place. The light-weight bracket takes only a few minutes to fabricate by welding, and provides a sturdy, dependable unit for suspending any overhead piping used in power plant and process operations.

Cleveland, O. J R MORRILL
Lincoln Electric Co

Pointers for Oil Circuit-Breaker Maintenance

MOTOR-STARTING oil circuit breakers are designed for general starting service. When properly applied they protect the motor from overloads, short-circuits and guard against the sudden application of full voltage to the motor after it has come to rest.

The frequency of inspection and maintenance depends upon the severity of the duty which the breaker must perform and the condition of operation. Usually a light monthly inspection with a thorough inspection and maintenance semi-annually should be satisfactory. However, in some cases breakers operating under active and severe service may require more frequent attention. Other breakers that operate infrequently, and under less severe duty, will naturally require less attention. The frequency of inspection will be largely determined by experience. Ten points to check for maintenance are:

1. Before making any adjustment to an oil circuit breaker, make sure that all lines leading to it are dead.

2. Be sure the breaker frame is grounded.

3. Do not operate the breaker ex-

cessively by the electrical operating mechanism when the oil tank is removed.

4. Examine all contacts frequently, especially after severe short circuits, to see that they align properly. Dress or replace burned contacts to obtain a good fit between them.

5. After making adjustments, test the breaker by hand to make sure that it operates smoothly and correctly.

6. Inspect the oil regularly and after severe short-circuits. If it shows signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height for safe operation.

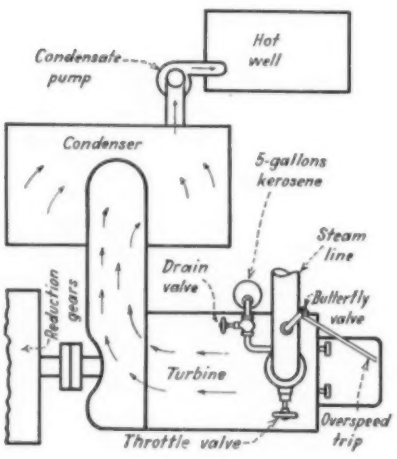
7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, and terminal bushings at least once a year.

8. Thoroughly inspect all bolts and nuts; tighten if necessary. Inspect all pins, links and bearings for excessive wear. Check all cotter pins.

9. Make dielectric tests of the oil every three months, to determine if it is reasonably good for circuit breaker work. Do not take samples until the oil has remained undisturbed for at least four hours. If testing for indication of water, take the sample from the bottom of the tank. For indication of carbon and after a heavy short-circuit, take the sample from the surface of the oil.

10. Arrange for regular inspection to see that the circuit breaker is in adjustment, the oil of good quality, and the complete breaker functions as required.

East Pittsburgh, Pa. N P WILSON
Westinghouse Electric & Mfg Co



Kerosene Bath Cleans Turbine Blades

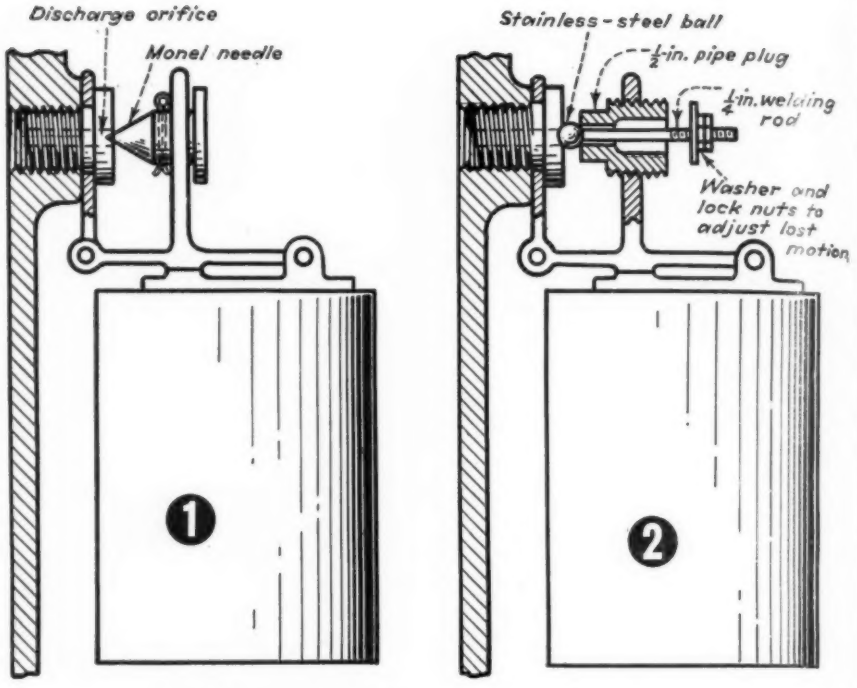
SOME YEARS AGO I worked in an old steam plant where we used an ingenious method of cleaning turbine blades and the steam side of condenser tubes. We placed a 5-gal can of kerosene to immerse the end of ¾-in. drain line that came from between the throttled valve and the butterfly valve, operated by the overspeed trip, as in the figure. The turbine overspeed mechanism was then tripped by hand to close the butterfly valve.

As turbine slowed down we opened the drain valve. By this time vacuum had come back through the turbine to the throttle valve, the turbine rotating as a result of its inertia. Because of the vacuum, the kerosene flowed from the can into the blades and cleaned gummy deposits off them as well as the condenser tubes. The arrows show direction of kerosene flow through turbine and condenser.

We could observe effects of this operation in the condensate returned to the hotwell. Sponges in this well removed the gummy deposits and the kerosene from the water. Cleaning, done once a month, required a few minutes only, care being taken to let the turbine rotor slow down to where there was no danger of kerosene striking the blades hard enough to injure them.

We opened a turbine shortly after cleaning and found the blades bright and shiny, where two years prior to using the cleaning process, the blades were covered with a gummy deposit when the turbine was opened up for scheduled inspection.

Great Neck, N. Y. S M ELONKA



Bearing Ball Replaces Needle Valve

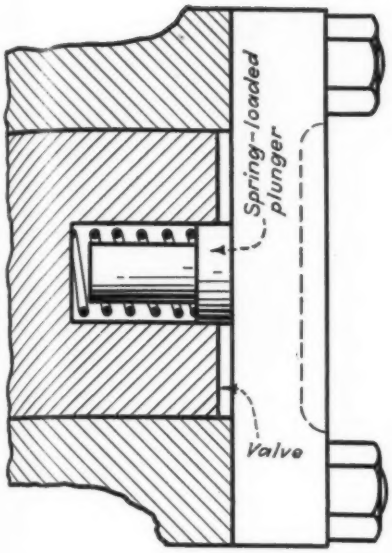
WHEN OVERHAULING an inverted bucket trap, we could not find the Monel needle for the valve, Fig. 1. Another needle was not available, nor was noncorrosive stock from which to make one. We solved the problem by using for the needle valve a stainless steel ball from a bearing, Fig. 2.

We silver soldered this ball to a piece of ¼-in. welding rod, which we threaded for adjusting nuts. The hole in the needle arm we tapped for a ½-in. pipe plug, through the center of which we drilled a ⅜-in. hole for the welding-rod valve stem. Clearance in this hole permits the ball to correctly seat in the discharge orifice when the bucket is up. Lost motion between the lock nuts on the valve stem and the pipe plug permits the ball to remain seated until bucket is well filled.

Marissa, Ill. GEORGE HOLMAN

Spring-Loaded Plunger Stops Valve Noise

WHEN cover-plate mating surfaces of the valve chambers of a 4-valve engine became worn to where they required a gasket, the valves were noisy at certain loads. We overcame this trouble by drilling one end of each valve and



fitting a spring-loaded plunger into each hole as in the figure. Even though it is small compared to the valve, these spring-plunger gadgets eliminate clatter, and keep the valve slot well back over the T-end of its stem.

Marissa, Ill. GEORGE HOLMAN

Groups of Extinguishers Improve Fire Protection

CERTAIN REPAIR AND MAINTENANCE WORK, such as welding, changing electrical fittings and handling inflammable materials may cause hazardous conditions that require extra fire precautions. One plant superintendent solved the problem by requiring at least one group of fire extinguishers near the endangered area, as in the photograph, where they are available for immediate use.

Six fire extinguishers are mounted inside an easily made welded-pipe inclosure, with a separate compartment for each one. This group supplements but does not replace any of the units located in and around the plant. It is delivered by a small hand truck and placed in a readily available location where work presents a serious fire hazard.

Prior to inaugurating the system, a typical response to an alarm was for men to run to the fire, then turn back and search for extinguishers mounted at various parts of the plant. In several instances, small fires grew to dangerous proportions before proper equipment could be brought into service. Now each man going to a fire has an extinguisher ready for immediate use, following discovery of a blaze.

Pomona, Calif. G M WILSON

Accumulator Smooths Refrigeration Operation

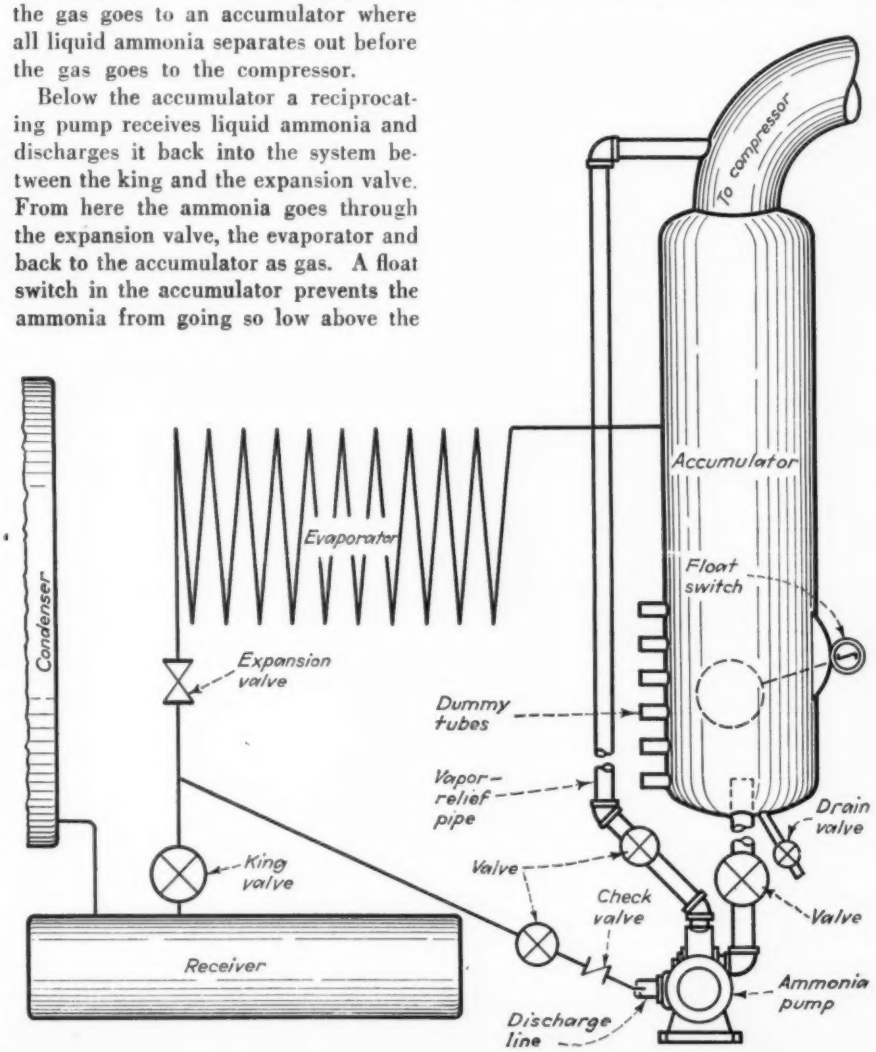
MANY OLDER REFRIGERATING PLANTS, equipped with slow-speed compressors, have to guard against the possibility of liquid ammonia entering the compressor cylinder. The drawing shows an equipment arrangement that removes this difficulty and also permits speeding up of the compressor. From the evaporator the gas goes to an accumulator where all liquid ammonia separates out before the gas goes to the compressor.

Below the accumulator a reciprocating pump receives liquid ammonia and discharges it back into the system between the king and the expansion valve. From here the ammonia goes through the expansion valve, the evaporator and back to the accumulator as gas. A float switch in the accumulator prevents the ammonia from going so low above the suction pipe as to cause the pump to become gas bound.

Pump capacity is small and must discharge against pressure up to 250 psi, therefore the pump operates at slow speed. For this pump to operate successfully it must be so designed that it does not contain pockets in which gas can accumulate and it should have very close clearances.

The accumulator must be located as high as space permits above the pump so as to make the suction head on the pump as high as possible. Gas glasses are not used on the accumulator, therefore dummy tubes that extend through the insulation are provided. The ends of these tubes frost when they contain ammonia. Extend the suction pipe up into the accumulator to provide space at its bottom for the accumulation of sediment and oil. Make the suction pipe as large as possible and run it directly vertical into the pump. Run a vapor vent pipe from pump suction chamber to the compressor suction pipe. When pump is idle vapors released in it will be drawn out and leave the pump to handle liquid when started.

Hempstead, N. Y. HARRY A SCHREIBER



READERS' PROBLEMS

Questions From Our Readers

Question 1

What Size Condensate Tank?

I would appreciate information on good practice in determining size of condensate tanks relative to boiler capacity, taking into consideration various steam loads.

Since the tank absorbs surges in boiler demand for water and the returning condensate, it must be sized accordingly. I fully appreciate that boiler demand for water and uneven condensate return depends on type of load, such as sudden demands for large quantities as against steady steam flow. What size tank do you use?

I would like opinions of other POWER readers on this subject.—*MP*

Question 2

Coarse or Fine Sandpaper?

What grade of sandpaper gives best results when sanding-in commutator or collector-ring brushes? Naturally, the coarse size cuts faster but it also produces a rough finish. Does this roughness produce brush contact quicker than a smooth face produced by fine sandpaper?

If the brush face is shaped true isn't a smooth contact preferable to one of sharp ridges?

Will one grade of paper fill interstices between grains of sand with carbon faster than another grade? And does this filling have any effect on accuracy or trueness of the sanding? If brush shape fits the commutator accurately does roughness of contact affect breaking-in of new brushes?—*ADP*

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Answers to Sept. Question 1

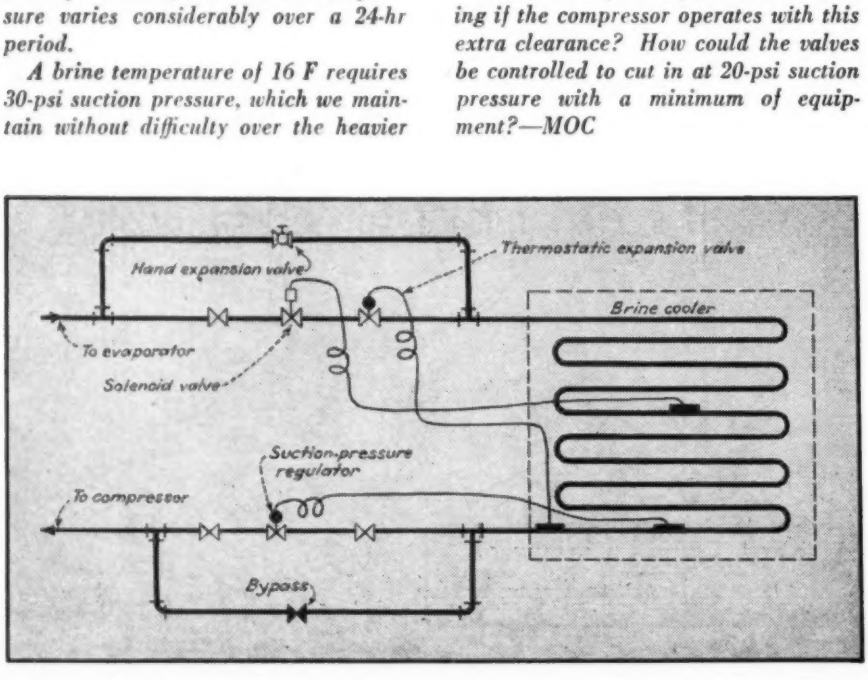
Needs Suction Pressure Control

WE HAVE TWO *diesel-driven ammonia compressors, each direct connected to a lighting generator in our ice-making plant. Since the generators require constant-speed drive, ammonia suction pressure varies considerably over a 24-hr period.*

A brine temperature of 16 F requires 30-psi suction pressure, which we maintain without difficulty over the heavier ice load periods. Frequently the refrigerating load changes, and the suction pressure drops as low as 15 psi. Naturally we want to save oil instead of wasting it and are investigating the possibilities of partially unloading the compressor.

The cylinders are fitted with clearance pockets and the necessary valves but no control equipment is installed. Rough measurements indicate that clearance volume is about 5% of cylinder volume or enough to raise the suction pressure an appreciable amount.

Could we expect any substantial saving if the compressor operates with this extra clearance? How could the valves be controlled to cut in at 20-psi suction pressure with a minimum of equipment?—MOC



Explains The Control

MOC's most practical solution, illustrated by the accompanying sketch is to control compressor suction pressure over the desired range by installing a suction-pressure regulator. To control the brine temperature he should include in his control, a solenoid valve and a thermostatic expansion valve.

The solenoid valve controls the brine temperature and is actuated by a thermostatic switch with its control bulb located in the brine cooler. When the solenoid coil is energized it lifts the iron plunger, which in turn snaps a needle valve open.

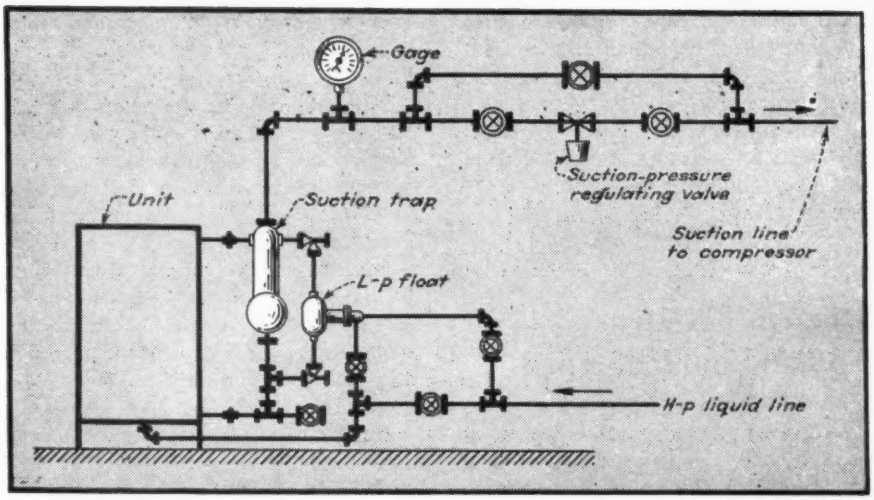
The solenoid-valve control switch makes and breaks the electric circuit through the coil, thereby controlling liquid-refrigerant flow through the expansion valve to the brine cooler. Actuating bulb is filled with a volatile substance so that temperature changes in the brine surrounding the bulb produce corresponding pressure changes of the actuating medium within the bulb.

The control bulb must be clamped on or located in the suction line to the compressor close to the brine cooler so that changes in the gas temperature as it leaves the cooler, are transmitted to the expansion valve.

Installing a suction-pressure regulator is optional. If MOC makes the other suggested changes, he can control suction pressure without a regulator.

When a suction-pressure regulator is installed it is desirable to increase size of evaporator coils. The 5% clearance volume may not be sufficient to maintain the desired back pressure under all load conditions, so in my opinion the other suggested changes are the best solution to his problem.

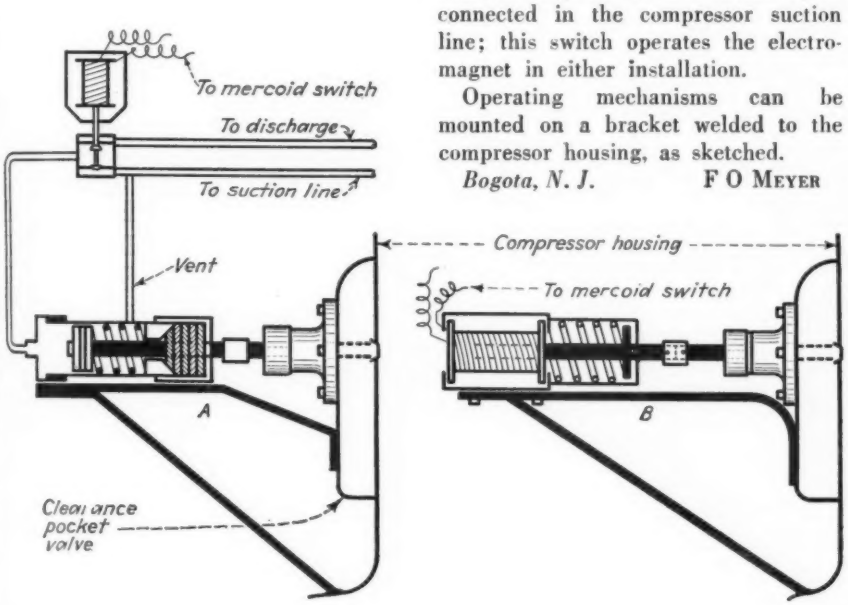
New York, N. Y. PAT DONOHUE



Suggests Two Methods

Here are two ways to make MOC's unloader valves operate automatically. The material should be in any power plant, except perhaps the electrically operated 3-way valve.

First prepare stem and bonnet of the unloader valve by removing the threads from both. Then fit the bonnet with a bushing that makes a good sliding fit on the stem, so designed that there is room for packing; the same nut can be used. Perhaps a new stem may have to be made as cutting off the threads may weaken the old one. Now make the following operating mechanisms:



(1) Build a housing to hold a heavy-duty electromagnet, *B*, in front of which is mounted a spring, acting on a shoulder of the plunger shaft, tending to keep the unloader valve closed; the magnet opens the valve.

(2) Make a cylinder and piston (fit piston with rings or packing as it must be as nearly gas tight as possible). Mount a spring in back of piston to open the unloader valve—piston keeps it closed. Of course, it could easily be designed to operate in reverse. Pressure or release of pressure in the operating cylinder, *A*, is controlled by a 3-way valve operated by a solenoid and connected in the discharge and suction lines. The outlet is connected to the compressor cylinder.

A pressure-operated switch (which can be adjusted to operate at any predetermined pressure as differential) is connected in the compressor suction line; this switch operates the electromagnet in either installation.

Operating mechanisms can be mounted on a bracket welded to the compressor housing, as sketched.

Bogota, N. J. F O MEYER

Side Pockets Lose Heat

I suggest that MOC use automatic or hand-operated capacity-reducing devices, instead of controlling load by various sizes of machinery. Such unloading devices are used on vertical machines, which allow the gas to pass from the cylinder back to the suction of the compressor through a port in the side of the cylinder walls.

It is a satisfactory method when properly designed and has little or no effect upon the indicated horsepower per ton. MOC should have the plant designers redesign for automatic operation; or perhaps the equipment manufacturer may have just the thing he is looking for. Experiments show that the only clearance that does not affect the indicated horsepower is that directly at end of piston. When clearances are put on the outside of the cylinder through port holes, part of the heat of compression escapes, and this energy is lost when the gas is re-expanded.

With any capacity-reducing device, there is always an increase in bhp per ton because frictional horsepower is practically constant for constant-speed machines.

Different methods of unloading compressors show that with the clearance in the safety head directly above the piston, there is no change in the indicated horsepower per ton, whether the ratio is two or ten and the capacity 50 or 100%. But the use of clearance pockets shows anywhere between 4 and 15% increase in indicated horsepower per ton, between 3½ ratio and 10.3 ratio of compression, changing from 100 to 50% capacity.

A suction-pressure regulator, to maintain a higher suction pressure in one part than in another part of the system, is used extensively for milk and water coolers, and in some places for automatic equipment where constant room temperature is required, so that the refrigerant is automatically shut off from a room, as in the sketch above.

The machine, beyond the suction-pressure regulator, is operated by various unloading devices in order to take care of the different loads.

Fairview, N. J. M N GOZDENOVICH

Compares Costs

Unfortunately, MOC did not state refrigeration and compressor capacity, nor condensing pressure. He can maintain a certain suction pressure through clearance pockets at the expense of the unit's volumetric efficiency.

We assume his refrigeration plant consists of 50-ton units, operating at 165 psi gage (89 F) condensing pres-

sure and 30 psi gage (16.7 F) suction pressure. Theoretical hp requirements are 50 × 1.021 = 51.05. Anticipated operation requires, with the same condensing pressure, but 20 psi gage (5.7 F) suction pressure, 50 × 0.966 = 48.30 or a difference of 2.75 hp.

Schenectady, N. Y. CARL BACHMANN

Horsepower Depends on Ammonia Pumped

To solve MOC's problem without a detailed description of the compressor, it is necessary to set up a hypothetical case and from the results draw certain conclusions given in the table:

	Peak Load	*Off-Peak Load*		
Clearance	5%	5%*	15%**	10%**
Suction pressure	30	15	30	25
Discharge pressure	200	200	200	200
Actual cfm NH_3 pumped	11.4	8.8	6.0	7.2
Tons refrigeration	4.4	2.3	2.3	2.8
Bhp	5.9	4.2	3.08	3.9
Bhp per ton	1.34	1.83	1.34	1.4
Volumetric efficiency %	70	54	36.5	41.2
Piston displacement cu in.	16.3	16.3	16.3	16.3
Compression ratio	6.66	13.3	6.66	8.0
Savings in bhp	.....	1.7	1.12	1.4
Clearance pockets	No	No	Yes	Yes

* No regulation; **regulation.

Assuming an initial cylinder clearance of 5%, it is necessary to add 10% more by opening pockets in order to get 1.12 bhp saving.

Specific fuel consumption may be obtained from the engine manufacturer, but may be taken conservatively as 0.43 lb oil per hphr for compression-ignition oil engines, and 0.55 lb for surface-ignition low-compression engines. Thus, for each hour running offpeak with clearance pockets open, saving for surface-ignition low-compression engines is 0.55 × 1.12 = 0.62 lb per hphr.

If the machine has small clearance, adding 5% clearance pockets does not substantially reduce bhp per ton. However, if the compressor has large-pocketed heads the 5% additional clearance brings an appreciable saving.

We see from the table that even without regulation on off-peak loads and low-suction pressure of 15-psi gage, savings are 1.7 bhp because horsepower consumed depends on weight of ammonia pumped.

If there are other attendant operating difficulties, the additional 5% clearance, besides that added by clearance pockets, may be made up by increasing head-gasket thickness or adding a larger head.

I suggest running the compressor at off-peak loads and opening the clearance-pocket valves manually. If the suction pressure runs in the neighborhood of 30-psi gage, savings will be about one bhp.

Opening clearance pockets with solenoid-operated valves, controlled by a suction-pressure switch energizing the solenoids, reduces capacity automatically. When suction pressure goes below 20-psi gage, solenoid valves are energized and the clearance pockets go into use. See sketch below.

Cliffside Park, N. J. J D CONSTANCE

Unload Cylinders Equally

Fortunately, MOC's compressors are fitted with valved clearance pockets, or what we usually call *partial bypass controls*, and it is entirely feasible to fit these with automatic valves.

Leading refrigerating-equipment manufacturers supply valves for these machines, which have proved entirely satisfactory. Hookup is simple and about as foolproof as any automatic device can be. One well-known manufacturer uses a valve fitted with a piston operated by the discharge gas pressure, which in turn is controlled by a small solenoid valve. Operation of the solenoid valve can be regulated by a low-pressure mercoid switch in the suction line, or a thermostat in the brine. Automatic valves fit the same openings containing the hand-operated valves and installation is simple.

MOC can expect a decided saving in fuel if he makes this installation. His head or condenser pressure is fixed, depending on condensing-water temperature and quantity or, if he has an evaporative condenser, on atmosphere, temperature and humidity. The higher the suction pressure, the less his power consumption. He can prove this to his own satisfaction by operating the bypass valves by hand when suction pressure is low, provided he has some reliable means of checking oil consumption. A word of caution, however: If the compressors are 2-cylinder machines, valves on both cylinders should operate simultaneously so that machine does not run unbalanced. Don't attempt to change one side only.

New Rochelle, N. Y. A B DURYEE

Use Suction-Pressure Regulator

MOC should install a suction-pressure regulator in the line from the brine cooler to the compressors. This regulator should have a bypass so that under the heavier icemaking loads, it can be bypassed. If there is a common suction line from the evaporators with a branch line to each compressor, one suction regulator will suffice.

Suction-pressure regulators function to decrease temperature difference, which would otherwise exist, between the brine in the cooler and the surface of the evaporator coils. Amount of heat carried away by the evaporating refrigerant is directly proportional to the temperature difference; therefore, installing suction-pressure regulating valves in a given ice-making plant requires more evaporator surface than would otherwise be necessary.

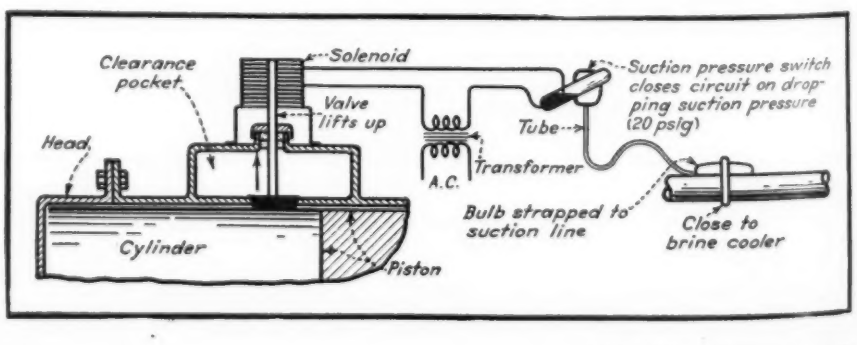
It is, therefore, not good practice to install a suction-pressure regulating valve in an existing icemaking plant without increasing the evaporating coil surface, but in MOC's case, where the requirements are only for light-load periods, this valve is the minimum equipment for a satisfactory solution.

New York, N. Y. J J FOY

Answers to Sept. Question 2

Valves Won't Regulate

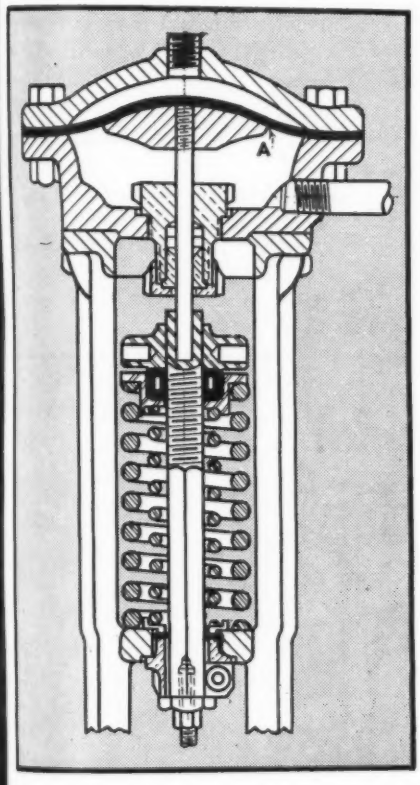
SEVERAL FILTERED-WATER LINES *supplying water to different elevations in our*



plant are each equipped with a pressure-reducing valve. A small spring-opposed metal-diaphragm pilot valve operated by downstream water pressure controls the main valve diaphragm. The lines feed washrooms, air-compressor jackets, drinking fountains and other outlets and only rarely must the valves regulate against dead-end pressure.

We have been unable to adjust the valves so that they will maintain anything like a steady pressure. Line pressure surges continuously, sometimes as high as 40 psi. For example, on one line we try to maintain 60 psi but the pressure-gage hand swings almost continually from 40 to 80 psi. Main- and pilot-valve seats are in good condition, and the needle-bleed valve, on the line between pilot and main diaphragm, is unobstructed.

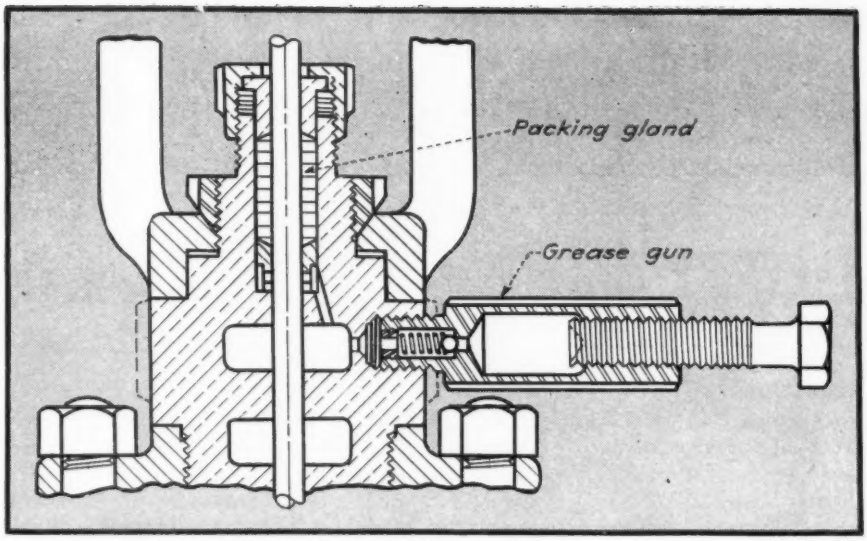
No amount of cleaning or adjustment improves valve operation and I am at a loss to understand the reason for this



annoying pressure fluctuation. It is impossible to keep drinking fountains adjusted: one second the water just trickles from the mouthpiece and the next second it squirts a 2-ft stream. What can we do to remedy this situation?—DWL

Incorrect Size Or Style

Full diaphragm power is applied to the stem, in valves like DWL's, only as long as diaphragm *A*, in the sketch, remains



in full contact with the diaphragm head. Whenever valve assembly or improper adjustment causes the diaphragm to bow away from the head, the stem receives less force, at a time, perhaps, when spring compression is greatest.

The inner valve, using either poppet port, V-port, ratio plug or throttling plug, is available with either single or double ports. Poppet port is used when quick opening at maximum capacity is needed. V-port develops close throttling during the first 25 to 30% of travel, and continues this control until maximum capacity is reached. Ratio plug throttles closely during the first half of its travel, but the port area opens at a much faster rate after the plug passes mid position. Throttle plug produces close action during the first 10% of travel; additional lift increases port area at a greater rate per unit of lift, giving essentially a straight line relation between travel and flow. A single-ported valve gives tighter closure than a balanced double-port, but line pressure acting on the disk affects its free movement.

Erratic operation can also be caused from installing a valve too large for the service. Naturally, the valve should not be too small, but it is just as important not to be too large. An oversized valve not only gives uneven regulation but because of oversize the restricted opening subjects the seats to wiredrawing.

Chicago, Ill. C A Armstrong

Connect Pilot Line Properly

Wrong connections may cause DWL's trouble. When using the regulated pressure as the actuating medium, the pilot line should be connected on the downstream side of the valve. Don't make the connection in an elbow or pipe bend because erratic pressures occur at these points. Select a point in a straight section of pipe at least 10 ft from the valve. Use a globe valve in this line to throttle the pilot supply and to smooth out pressure pulsations.

The valve bodies, marked as to flow direction, must be inserted in the line to conform with the marking. A correctly chosen valve does not necessarily match the pipe size. When the valve is smaller than its supply line reducing flanges or bushings can make connections. Although this saves space, bell or venturi reducers give better flow conditions.

Another source of trouble is old and dry packing drawn up tightly to prevent leakage. If the valves are equipped with lubricators, as in sketch, see that they are kept filled and the packing lubricated. When packing becomes dry and hard replace it with new.

New York, N. Y. R M Ransing

Is Piping Undersized?

Normal pressure variations in DWL's pipelines are chiefly functions of flow rate, actual pipe size and smoothness of pipe walls. A check at the pumping station should include measurement of water flow as well as discharge pressure covering a cycle of typical extreme maximum and minimum variations. If centrifugal pumps are installed, minimum total dynamic head at maximum demand must be higher than the maximum regulated head on any branch line. If pumping station conditions are satisfactory make a survey of distribution mains, measuring or estimating the maximum flow rates in each section,

(*Continued on page* 164)

Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

8—*Safety Valves, Water-Level Alarms, Fusible Plugs*

Eighth in a series that is running in every number of POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment—its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the oldtimer's knowledge, helps all comers pass engineer examinations and win certificates of higher grade. Besides being invaluable as a study course for examinations, it is a good review for the chief himself who wants to do a better job.—Editor*

Q 1—What is the function of the boiler safety valve?

A—It prevents boiler pressure rising above a certain predetermined pressure by opening and allowing excess steam to escape to the atmosphere when that point is reached, thus guarding against a possible explosion through excessive pressure.

Each boiler must have at least one safety valve. If the boiler has more than 500 sq ft of heating surface it should have two or more safety valves. In any case, safety-valve capacity must be such as to discharge all the steam the boiler can generate without allowing pressure to rise more than 6% above highest pressure at which any valve is set, and in no case more than 6% above the maximum allowable working pressure. All safety valves must be direct spring-loaded pop type.

Q 2—Explain operation of spring-loaded pop safety valve.

A—It opens suddenly with a popping sound when the steam pressure reaches the point at which the valve is set to blow, hence the name, "pop." This quick action is obtained in all pop valves by some method of suddenly increasing the upward force on the spring that holds the valve down on its seat. For example, an extension or lip on the valve presents a greater area to the upward pressure of escaping steam as soon as the valve opens.

It is held open until the pressure drops a few pounds. Then it closes just as suddenly as it opened. This quick opening-and-closing action prevents "wiredrawing" of the steam and probable grooving of valve and seat.

Q 3—What would cause a safety valve to stick to its seat?

A—The cause would most likely be corrosion of valve and valve seat due

(*Continued on page* 120)

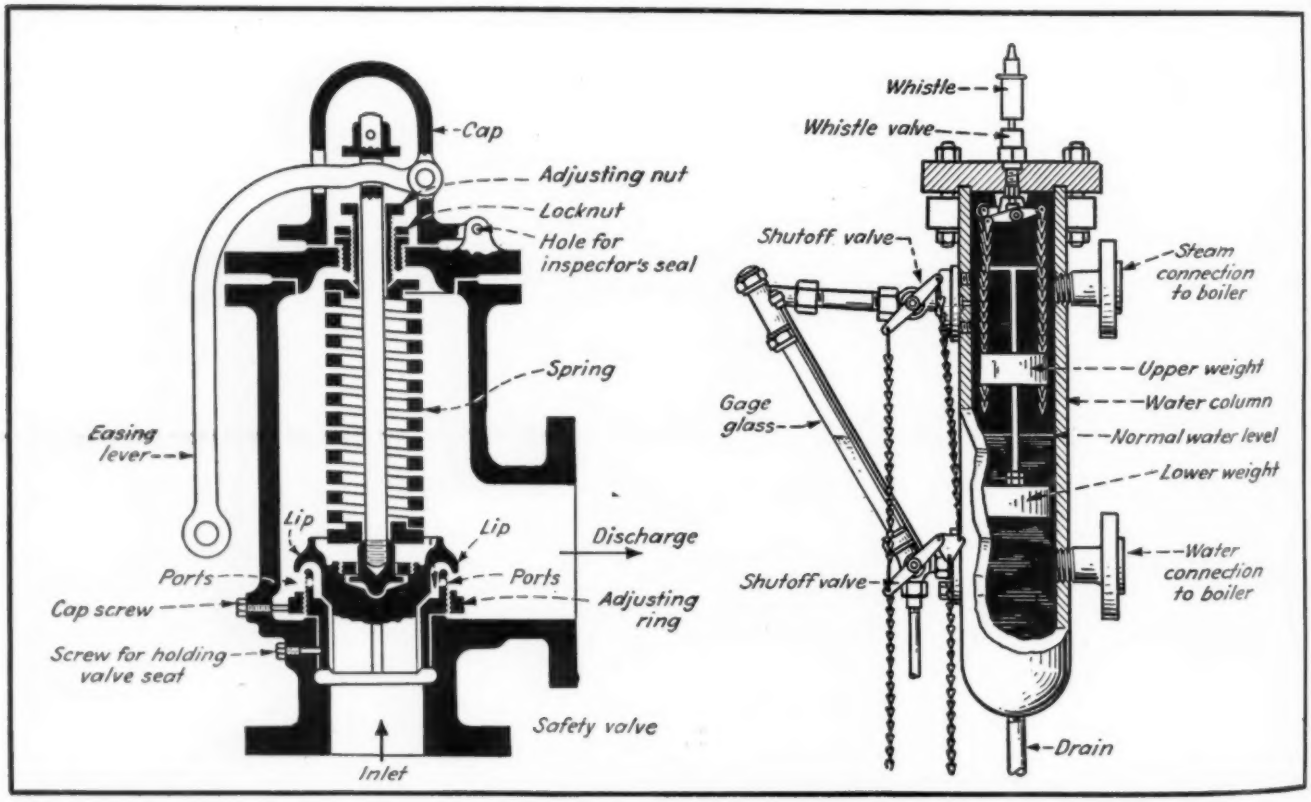


Fig. 1—Safety valve with inside spring. Fig. 2—Water column with high and low-water alarm

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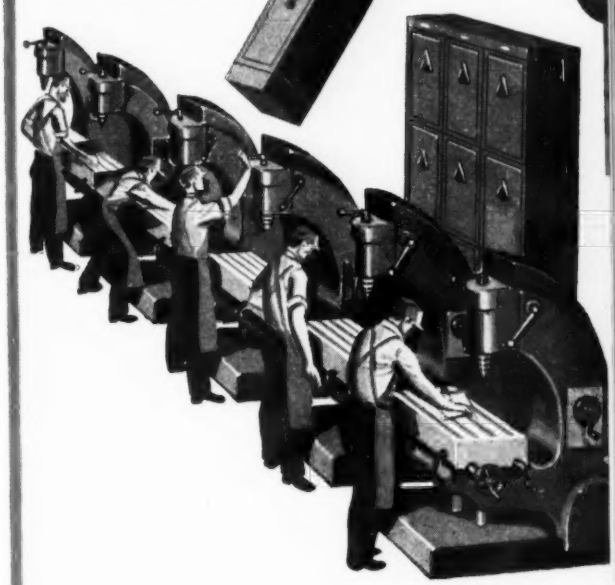

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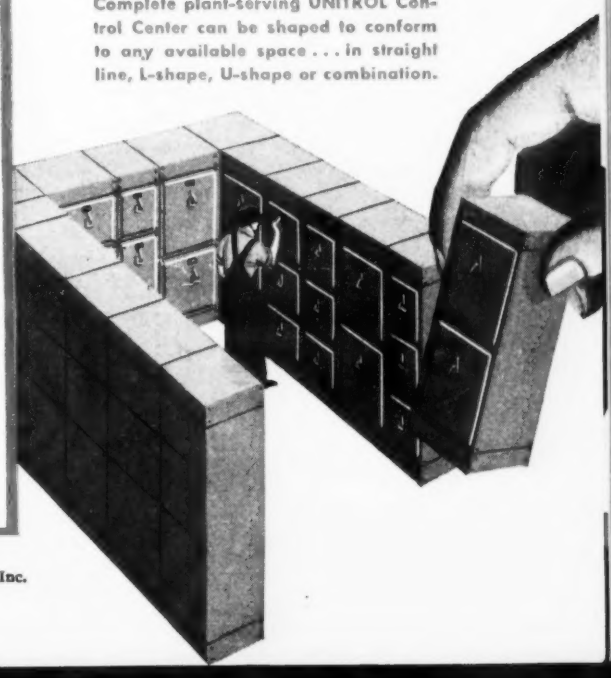
Complete plant-serving UNITROL Control Center can be shaped to conform to any available space . . . in straight line, L-shape, U-shape or combination.



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UNITROL
C-H

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Q&A FOR POWER ENGINEERS

(*Continued from page* 118)

to not being opened for a long period. To avoid this most dangerous condition, allow the valve to blow off periodically by using the hand lever to raise it from its seat or, preferably, by raising the steam pressure to the popping point.

Q 4—Describe and sketch a spring-loaded pop safety valve.

A—A common cast-iron-body type is shown in Fig. 1. The valve disk is held firmly on its seat by a heavy coil spring. The point at which the valve lifts and relieves the pressure is set by screwing the adjusting nut up or down and so decreasing or increasing compression of the spring. A locknut keeps the adjusting nut from moving once it is set. Cap on top of valve may be sealed if desired, to prevent access to the adjusting nuts. A hand lever lifts the valve from its seat if it is thought to be sticking, and a blowdown adjusting arrangement regulates number of pounds that the valve blows down before it closes. Fig. 1 shows an enclosed spring. An exposed spring is used when high steam temperatures might affect proper operation of the spring.

Q 5—What is meant by blowdown of a safety valve, and how is it regulated?

A—Difference between the pressure at which the valve pops and that at which it closes is the blowdown. The valve remains open until the pressure falls a few pounds below the original popping point because when it does open a greater area of disk surface is presented to the upward rush of escaping steam and further upward pressure is exerted on the valve lip. In Fig. 1 the amount of blowdown may be varied by raising or lowering the adjusting ring on the outside of the valve seat, thus decreasing or increasing the area of the small ports through which the steam escapes from the "huddling chamber."

ASME Code requires blowdown adjustment to be made in the factory and sealed. Changes, which are required in the pressure at which the valve pops or in the amount of blowdown, should be made by the boiler inspector or other competent person.

Q 6—What are some points to consider in attaching a safety valve to a steam boiler?

A—Connect the valve as close to the boiler as possible with no unnecessary pipe or fitting between. No other valve of any description may be placed between boiler and safety valve, nor on any escape pipe from it to the atmosphere. If a discharge pipe is used, it must have an open-ended drain to prevent water lodging above the valve. Locate all safety valves so that the discharge is clear of running boards, working platforms or any other place where escaping steam is likely to scald any one. Connect every safety valve in an upright position with the spindle vertical. The valve must not be connected to an internal pipe and the hole in the boiler shell must be at least equal in area to the combined areas of all safety valves connected to the boiler. A muffler's construction must be such that it puts no back pressure on the valve.

Q 7—What is total upward force on a valve disk, 3 in. diameter, when boiler steam pressure is 150 psi?

A—Area of valve = Diameter squared × 0.785
= 3 × 3 × .785
= 7.07 sq in.

Total force = Area of valve × pressure, psi
= 7.07 × 150
= 1060 lb

Q 8—If downward force exerted by the spring of a safety valve is 850 lb and diameter of the valve disk is 2½ in., at what pressure will the valve open?

A—Area of valve disk = 2.5 × 2.5 × .785
= 4.91 sq in.

Opening steam pressure = Spring pressure ÷ valve area
= 850 ÷ 4.91
= 173 psi: answer

Q 9—Sketch and describe some forms of high- and low-water alarm.

A—The commonest form of high- and low-water alarm is a whistle placed on the water column and operated by rods and levers attached to floats or weights within the column. Movement of these weights or floats as the water level falls below or rises above the danger points causes the warning whistle to blow.

Fig. 2 shows a high- and low-water alarm of the solid-weight type. It depends for its action upon the well-known fact that a body weighs less in water than in air. Upper weight is in the steam space, and lower weight is wholly submerged in water. Water in Fig. 2 is about at normal operating level. In this position the weights are balanced and the whistle valve is closed.

If the level falls to a point where the lower weight is no longer submerged, the balance is disturbed. Lower weight, now unsupported, moves downward. This causes a corresponding upward movement of the upper weight which blows the warning whistle.

If the water rises so high that the upper weight is submerged, its downward pull is lessened and the balance disturbed so that lower weight again moves downward and upper weight rises, blowing the warning whistle as before.

The rods, by which the weights are suspended, are so attached to the short cross levers at the top that upper and lower weights must always move in opposite directions. Either low or high water moves the weights further apart and the resulting turn of the levers opens the steam valve to the whistle.

Q 10—What is a fusible plug?

A—This device protects boiler from damage through low water. It is a bronze plug having a fine thread on the outside and a tapered hole in the center filled with a soft metal alloy, which is almost pure tin with a melting point of around 450 F.

Plug is screwed into the boiler plate at some specified point above the highest point of the boiler heating surface that might be damaged by low water. In normal operation, one end of the plug is always covered by water while the other end is exposed to fire or hot gas. The tin filling does not melt as

(*Continued on page* 122)

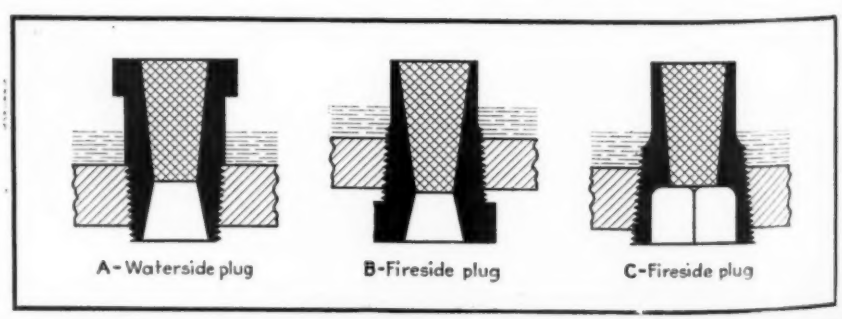
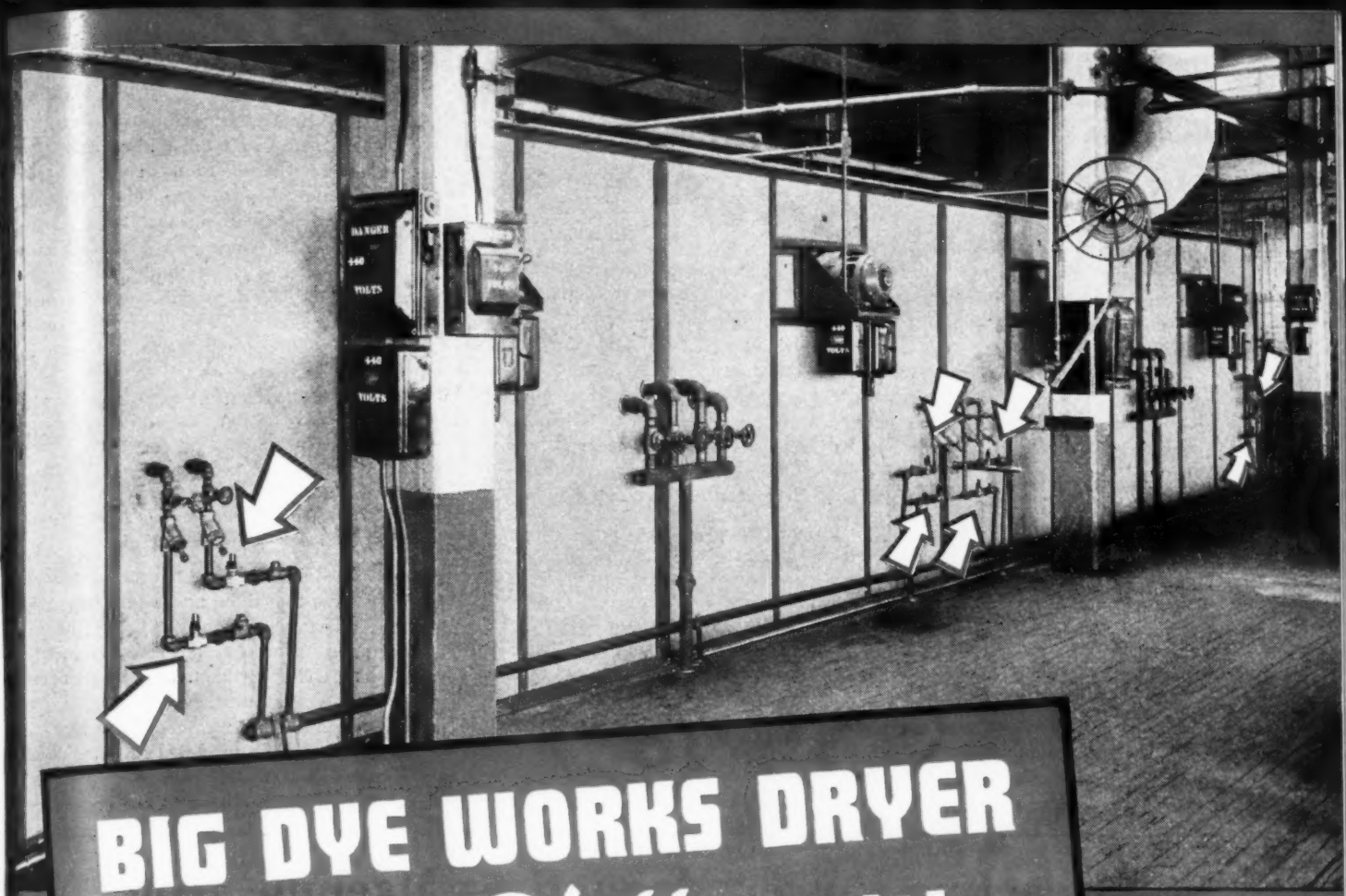


Fig. 3—Three types of fusible plug that are recommended in ASME Code



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"BECAUSE Yarway Traps discharge continuously on heavy condensate loads, they bring such equipment as our big dryer up to desired temperature quickly, and their intermittent discharge on lighter operating loads keeps it hot—improves efficiency."

This is the experience of the Richmond Piece Dye Works, Richmond, Va., where more than 35 Yarway Impulse Traps have been put to work, returning worthwhile profits in sustained heating efficiency and operating economy.

Then, too, their small size saves valuable space around machines. Their light weight simplifies installation. Their unique design with only one moving part—a simple valve and their rugged bar-stock construction, practically eliminates maintenance expense. And Yarway Traps are suitable for all pressures throughout the plant without change of valve or seat.

Good reasons why more than 250,000 Yarway Impulse Traps have been purchased; why more than 100 Mill Supply Distributors sell them. See your dealer or write for catalog T-1738. They usually cost no more than to repair an ordinary trap, so why not get Yarway performance for your money?

YARNALL-WARING COMPANY, 100 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

Q&A FOR POWER ENGINEERS

(*Continued from page* 120)

long as the plug is submerged, but if falling water level uncovers the plug, the tin melts and steam blows out of the central hole, thus warning of low water.

A fusible plug is not practicable in many modern boilers where pressures and temperatures are high and shells of drums are often thick, but it is still a valuable accessory in low- and medium-pressure boilers, especially in fire-tube ones. ASME Code gives correct location of the fusible plug in most well-known types of boilers.

Q 11—Sketch and describe some approved forms of fusible plugs.

A—Those recommended in ASME Code are shown in Fig. 3. The water-side plug, *A*, is screwed into the plate from the water side of the boiler; *B* shows a fireside plug, so called because it screws into the plate from the fire side; *C* is a fireside plug with the end recessed for a plug wrench to reduce the amount projecting beyond the plate surface. Plugs *A* and *B* have hexagonal ends and are screwed in with an ordinary wrench. Plug must project at least ¾ in. beyond the plate on the water side and should not project more than 1 in. on the fire side. The boiler pressure is always on the large end of the tapered soft-metal core.

Q 12—What care must a fusible plug receive?

A—Examine it every time the boiler is shut down for washing or inspection and clean all soot and scale off the ends. It must be renewed at least once a year.

Q 13—How would you refill a fusible plug?

A—ASME Code recommends that used casings be not refilled. But if it is necessary to refill a plug, heat it to melt out the old filling, clean the hole well and tin it. Next, place a small plug of putty in the small end of the hole, set the plug on a smooth-level surface with the small end of the tapered hole down and pour in some molten tin. When the plug cools, smooth off the end with a file and it is again ready for use.

When melting the tin, take care not to overheat it.

Q 14—Where should the fusible plug be placed in the following boilers: (a) HRT, (b) locomotive, (c) horizontal-drum water-tube?

A—(a) HRT boiler: in the rear head not less than 1 in. above the upper row of tubes. Measurement is taken from the upper surface of the tubes to center of plug; (b) locomotive boiler: in the highest part of the crown sheet; (c) horizontal-drum water-tube boiler: in the upper drum not less than 6 in. above bottom of drum over the first pass of the products of combustion.

Reactive Power Magnetizes Machine Iron

By R V SELANDER, *Utah Power & Light Co, Salt Lake City, Utah*

I WAS ESPECIALLY INTERESTED in MGW's question on power factor in March.

His power system must be supplied enough active power, or kilowatts, to operate all the connected load at rated frequency; also, enough reactive power to magnetize the iron in the inductive apparatus (generators, transformers and motors) that is connected to the system. Field circuits of generators and synchronous motors can supply the magnetizing current for these machines, but transformers and induction motors must get their magnetizing current from the system. The synchronous machines, then, must supply all the system's magnetizing current.

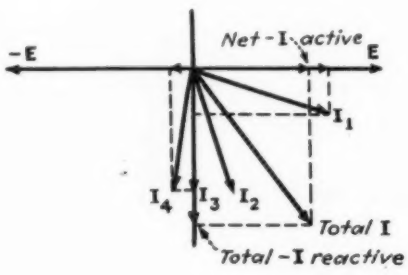
During periods of heavy system load, or low pf, the generators do not have enough current capacity to carry all the kw load and all the reactive load without overheating or operating at a lower terminal voltage. At such times, an additional generator can be overexcited to supply only the reactive.

When *E* is the voltage between phases and *I* is the current in one of the leads, pf is found from the equation:

$$\text{pf} = \frac{\text{watts}}{\text{E x I x 1.73}}$$

Substituting known values in above:

$$\text{pf} = \frac{400.000}{2100 \text{ x } 2000 \text{ x } 1.73} = .055 \text{ or } 5.5\%$$



When a generator and a synchronous motor are operating on the same bus, both have the same terminal voltage. But the motor voltage is 180 deg from the generator (bus) voltage, or the generator voltage reversed. A vector diagram, in the sketch, illustrates the mathematical reason for this convention.

Using the generator (bus) voltage as the reference vector *E*, a generator under load with an overexcited field has a lagging pf, or the phase current I_1 lags behind the corresponding phase voltage. If excitation is held constant and load is dropped off the generator, the pf lags more, I_2, until at the point where the generator is floating (neither taking nor supplying power), angle of lag is 90 deg, I_3.

If all driving power is now removed from the generator's prime mover, the angle of lag is more than 90 deg. Since pf is the cosine of the angle of lag, the cosine of an angle greater than 90 deg is negative. Components of the motoring machine's current would then be: a reactive component lagging the generator voltage 90 deg and an active component 180 deg from the generator voltage, or negative generator action.

Rather than show motor action as negative generator action, motor current is referred to the generator voltage reversed —*E*. There is then a reactive component leading the motor voltage 90 deg and an active component inphase with the motor voltage. The only reason motor current is leading and generator current lagging is that the current refers to opposing voltages. Note that whether the machine is motoring or generating, the reactive component is in the same direction, and therefore the reactive current affects the system exactly the same whether it is a lagging generator current or a leading motor one. You might visualize these conditions by saying that on an overexcited machine reactive flows out of it to the system, and on an underexcited one reactive flows from the system into the machine.

MGW's method of finding the station pf is incorrect. Generator and motor

(*Continued on page* 168)

Maintenance Costs
HIT ROCK BOTTOM!

SOLNUS OILS

End Costly Carbon Troubles in Quarry Diesel

Diesel engines in quarry service operate under severe conditions . . . due to dust, temperature extremes and hard usage . . . resulting in difficult problems of lubrication and maintenance. Sun Lubricants and Sun Engineers have been successful in helping to overcome such problems in many quarry power plants.

In one instance, the diesel supplying power for a giant stone crusher had been lubricated by three nationally-known, high-quality diesel oils. With each of these oils, excessive hard carbon and gum deposits caused sticking rings and loss of power. Every time the engine was overhauled, it was necessary to *break* the rings to free them, resulting in high annual replacement costs.

After changing to SOLNUS Heavy for summer service and SOLNUS Heavy Medium for winter, carbon deposit was very slight and that which did form was so soft that it could be wiped away with a cloth. All piston rings (even the top rings) were free . . . and costs for replacement of parts were the lowest ever experienced.

This field report is typical of the many which we receive every year. It suggests that SUN Lubricants and SUN Engineers . . . those capable "Doctors of Industry". . . may be able to help you solve your difficult lubrication problems. Write to . . .

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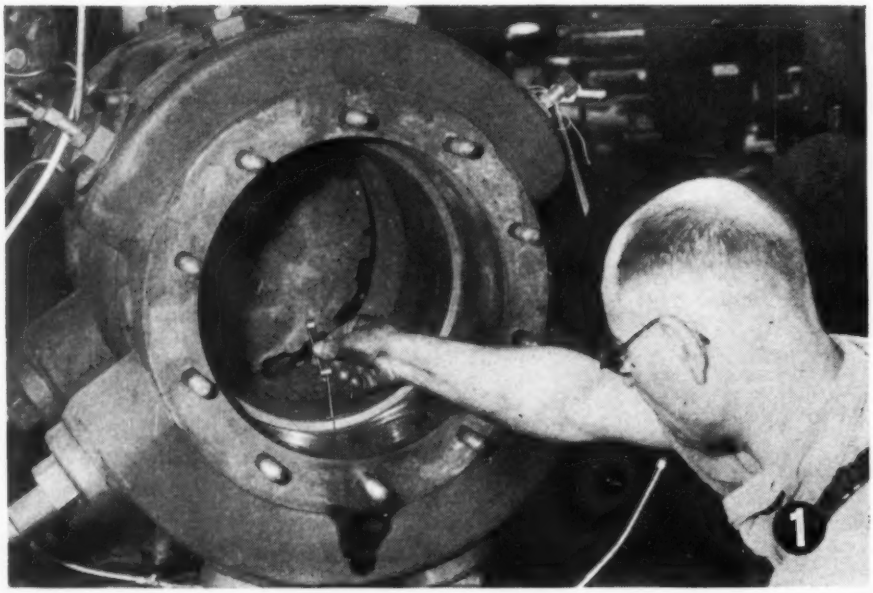
HOW TO INSTALL ONE-PIECE RINGS ON PISTONS



HANDLE PISTON RINGS carefully and fit them accurately to cylinder bore and piston groove so that machine gets full benefit of a good seal. Examine rings closely and smooth off burred edges. *Photographs courtesy American Air Compressor Corp, North Bergen, N. J.*

1 **Put new ring inside the cylinder bore with its joint at a convenient measuring position. Insert the ring making it assume a uniform contact with cylinder walls, which positions the circle in a true plane. Use a feeler gage to check ring gap; if necessary, file ends to spacing given in table.**

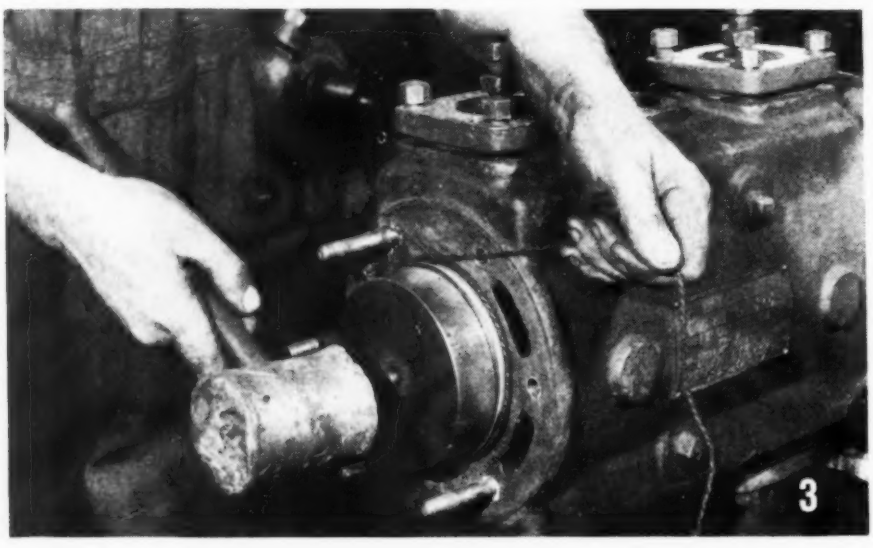
RING END CLEARANCE

Kind of machine	*Cylinder dia in.*	*Minimum side clearance in.*	*Joint end clearance, in., minimum*	
			Straight and step	*45 deg angle*
COMPRESSORS	Below 6	.0015	.003 x dia	.002 x dia
	6 and over	.0025	.003 x dia	.002 x dia
STEAM ENGINES				
Saturated steam	Below 6	.002	.005 x dia	.003 x dia
	6 to 12 15/16	.003	.005 x dia	.003 x dia
	Over 12 15/16	.004	.005 x dia	.003 x dia
Superheated steam	Below 6	.003	.008 x dia	.006 x dia
	6 to 12 15/16	.005	.008 x dia	.006 x dia
	Over 12 15/16	.006	.008 x dia	.006 x dia

Courtesy, American Hammered Piston Ring Div, Koppers Co.

2 **With the piston in this position, remove all foreign matter from grooves. Roll each ring entirely around the piston. If ring stays in groove from its own weight during this procedure, side clearance will check fairly close to value in table.**

Slide the back ring over metal-bridge strips across the foremost groove to position in rear groove (if more convenient remove piston and rod, thread piston rod through ring, and put it in groove from rear). Slip front ring into its groove. Ring faces must lie below piston lands.



3 **Loop a heavy cord around one stud, pass it outside and over the adjacent stud and then pass it around the entire ring. Pull on cord to constrict ring into its groove and tap or push piston home. If piston doesn't move easily, find out why; don't use a great deal of force.**

Official U. S. Navy Photograph

...BIDDLE INSTRUMENT REPAIR DEPARTMENT

These three "Megger" testers were on board the former liner *Normandie* when she capsized, were recovered after several months and sent to our Repair Department for whatever could be done with them. Although waterlogged and badly corroded, as shown here, we found they could still be salvaged. They were repaired, rebuilt and returned to service, practically equal to new, within three weeks' time—a tribute both to the inherent quality of "Megger" instruments and the craftsmanship of Biddle instrument makers.

For many years we have maintained an Instrument Repair Department for servicing, repairing and rebuilding "Megger" Insulation Testing Instruments, Tachometers, Frequency Meters and other specialties. Today this well-equipped and busy department is not only servicing equipment we have supplied, but also other types and makes of instruments.

Perhaps you have instruments lying idle that need only expert repairing to return them to service. If you are faced with difficulty and delay in procuring replacements, our Repair Department may be able to help you.

THE NEW . . . U. S.-MADE "MEGGER" INSULATION TESTER

in plastic molded case; with the heritage of ruggedness and accuracy common to all instruments bearing the trade mark name "Megger."

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ARGUMENT CORNER

Sticks to His Guns for Inside-Lap Stack Joints

IN JULY 1943 Argument Corner, J H Carr comments on steel-stack design. I agree with him that most steel stacks with riveted joints are probably built with old-style shingle-lap joints, Fig. 1, but I believe Dick Snider is on the right

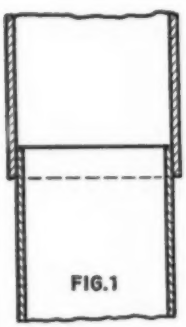


FIG. 1

FIG. 2

track when he makes stack joints like Fig. 2. For the last 25 years I have been an active campaigner for better stacks by using inside-lap construction. A properly welded steel stack eliminates adverse effects by lap joints, but if joints are to be riveted or bolted, give them an inside lap.

For an unlined stack in active service practically all metal loss from corrosion occurs on the inside surface or in the laps. Flue gas contains all the corrosion-producing properties of the air plus moisture from fuel and more or less sulphur. Sulphur products are especially detrimental because not only are they corrosive but they elevate the dewpoint of the gas. By contrast, outside surface of the stack is exposed to relatively clean air at a temperature averaging well above the dewpoint.

The average stack is made of light plate with commercial-fit joints. It is unusual to find a stack with tight metal contact on both edges of every joint; therefore some leakage into or through the joints must be expected. Any leakage from a joint like Fig. 1 is corrosive fluid from the inside into the contact faces of the joints, or through them to the outside. The latter appears in streaks and stains that seriously affect stackpaint life and appearance. In contrast, with the inside-lap joint, Fig. 2, leakage is relatively harmless fluid from outside to inside.

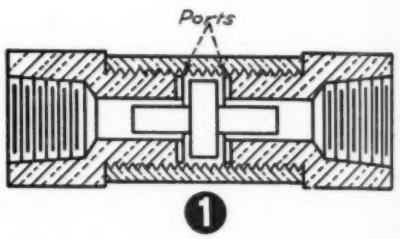
Every stack is entitled to at least one coat of paint and most stacks get additional coats as required. With inside-lap girth joints, paint, when applied to outside of an erected stack, tends to run into any opening in the joints and seal them and also tends to form a water-shedding fillet on the top edge of the stack plates.

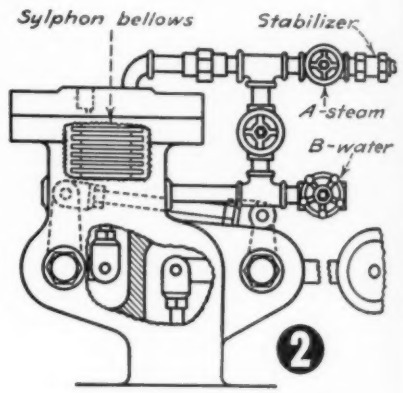
Based on many years' experience with and observation of steel-plate stacks, I believe that life and appearance of any riveted or bolted lap-joint stack is improved by using inside instead of outside lap joints. Improvement may vary from a little to a great deal, but it is invariably in the right direction. Since there is no difference in first cost why not join the campaign for better steel stacks and inside-lap girth joints?

San Francisco, Calif. M S GEREND

Stabilizer Steadies Pump Governor

I HAVE READ WITH INTEREST the operating suggestion by M N Gozdenovich entitled "Ball Check Valve Steadies Pump Governor" on page 108 of June POWER. While the use of a ball check valve has apparently been successful in dampening pressure pulsations in this instance, I do not recommend it as general practice. Unless it is provided with leak or



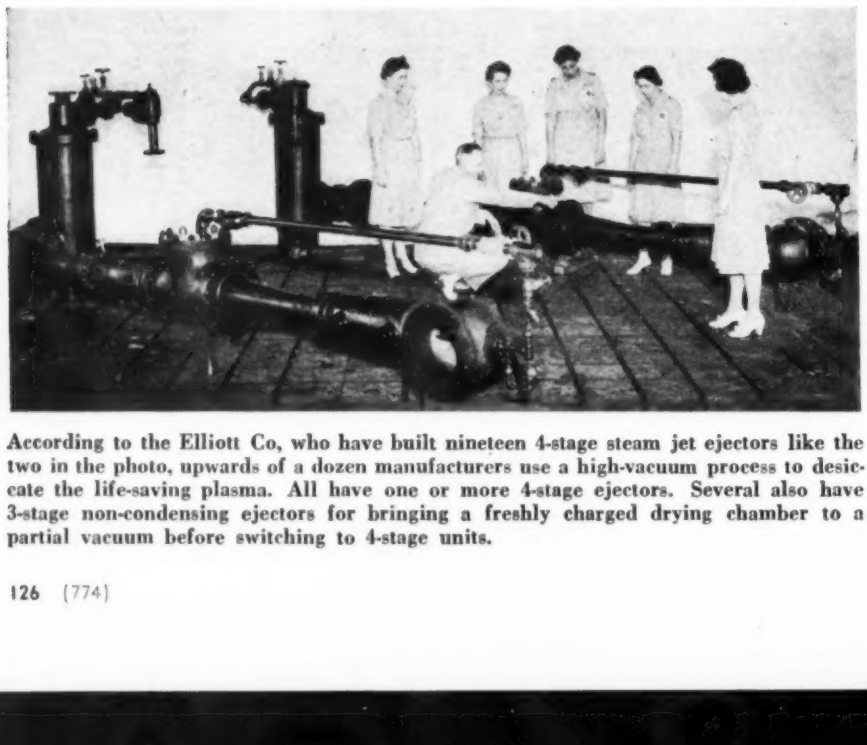


bleed ports, a tight seating check may prevent all motion of the governor in the direction which the ball seats, resulting in incorrect average pressure.

A better method is to use the stabilizer shown in Fig. 1. This is a double check valve, with small leak ports in each seat, designed specifically for dampening pressure pulsations. Another good remedy is to throttle the needle valves A and B, Fig. 2. Usually if they are cracked about ¼ turn, excellent results are obtained.

Erie, Pa. L. D. CARLYON
Northern Equipment Co.

RED CROSS WORKERS LEARN ABOUT BLOOD-PLASMA PROCESS



According to the Elliott Co, who have built nineteen 4-stage steam jet ejectors like the two in the photo, upwards of a dozen manufacturers use a high-vacuum process to desiccate the life-saving plasma. All have one or more 4-stage ejectors. Several also have 3-stage non-condensing ejectors for bringing a freshly charged drying chamber to a partial vacuum before switching to 4-stage units.

For low cost power in stationary service installations, Baldwin Diesel Engines have an outstanding record of economical operation and maintenance the country over.

Baldwin has built diesel engines for practically every application. They provide unfailing low cost power in ice plants, industrial and commercial plants, textile, cotton oil, and flour mills, public buildings, hotels, and colleges. Recent statistics on one Baldwin Diesel installation showed a maintenance cost for replacement parts of 5c per horsepower per year over a ten-year period.

The knowledge and experience gained in 49 years of diesel engine manufacturing is built into every Baldwin Diesel. Whatever your power requirements, regardless of the type of service, it will pay you to consult Baldwin. The Baldwin Locomotive Works, Philadelphia, Pa.

ARMY NAVY

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DIESEL ENGINES

ENGINEERS' BOOKSHELF

Electronics

EXPERIMENTS IN ELECTRONICS AND COMMUNICATION ENGINEERING (1943) *By E H Schulz and L T Anderson, both instructors in Electrical Engineering, Illinois Institute of Technology. Published by Harper & Brothers, 49 E 33rd St, New York, N. Y. 381 pages, 6x9 in. illustrated. Price* $3.00.

Intended as a laboratory text for courses at college level in electronics, communication networks, radio and ultra-high-frequency phenomena, this guide to laboratory work contains 108 experiments, ranging from simple dc measurements to complete amplifiers, radio receivers and transmitters, microwave equipment, etc. The text was prepared for war-training courses, especially Army and Navy college training programs, ESMWT, and other accelerated war-training programs, and as a guide to laboratory work in electronics and ultra-high-frequency training schools of the U. S. Army Signal Corps.

Two preliminary chapters discuss laboratory technique, use of tools and procedures, circuit elements and measuring devices. The twelve remaining chapters, organized about the major topics, are devoted to experiments. Each chapter discusses briefly principles involved, procedure to follow and apparatus for every experiment. The student is able to work out all details of an experiment without consulting other references.

Mechanics

ENGINEERING MECHANICS (1943) *By Ferdinand L Singer, Assistant Professor of Engineering Mechanics, New York University. Published by Harper & Brothers, 49 East 33rd St, New York, N. Y. 482 pages, 6x9 in., illustrated. Price* $4.00.

Primarily a college text, this book presents illustrations and definitions in simple straightforward style so that it could well be used for home study or reference. Chapter headings include principles of statics, force systems, structures, friction, centers of gravity, moments of inertia, dynamics, work and energy, impulse, momentum and vibration. Graphic analysis methods are grouped and written as a single chapter.

Radiography

SYMPOSIUM ON RADIOGRAPHY (1943) *Published by American Society for Testing Materials, 260 S Broad St, Philadelphia, Pa. 265 pages, 6x9 in., 175 illustrations. Price* $4.00.

A bound set of 18 technical papers presented by outstanding authorities aimed at better understanding of radiographic tests and their significance to both consumers and producers. Papers discuss principles of radiography, foundry applications, gamma rays, inspection, welds and magnesium castings. In addition, a million-volt portable unit is described, application of X rays in boiler shop and power plant is discussed and recommended, industrial radiography terminology is given.

Electricity

INTRODUCTION TO CIRCUIT ANALYSIS (1943) *By Abner R Knight, Professor of Electrical Engineering, and Gilbert H Fett, Associate in Electrical Engineering, University of Illinois. Published by Harper & Brothers, 49 E 33rd St, New York, N. Y. 447 pages, 6 x 9 in., illustrated. Price* $4.00.

Written as a college text, this book attempts to give the student a physical conception of electrical engineering problems before analyzing them mathematically. It is intended as a basic course in electrical engineering, from which the student may proceed to more specialized courses, such as dynamo behavior, electrical design, electronics, electrical power distribution, etc.

First five chapters serve to: (1) provide understanding of fundamental elec-

(*Continued on page* 184)

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When considering the important contribution that women are making towards the war effort, don't overlook the Women's Industrial Auxiliary Corps.

Like their sisters in the service auxiliaries, these women workers in practically every type of war plant are today doing many of the "tremendous trifles" so important to all-out war production.

Here, American Flexible Low-Tension Shielded Conduit is being made ready for final assembly into a medium bomber built by a prominent Eastern plane builder. Threading electrical wires through the conduit and soldering on end connections was formerly done exclusively by men. Today, however, with a minimum of training, women are doing the job equally as well, and in many cases, faster.

Flying with our bombers is only one of the important jobs assigned to American Metal Hose products. In industry, various types of American Flexible Metal Hose and Tubing convey water, gas, steam and oil; it's also used in vacuum service for removing filings and dust; as misalignment connectors or for absorbing vibration in pipe lines—to name but a few applications where these products serve with distinction.

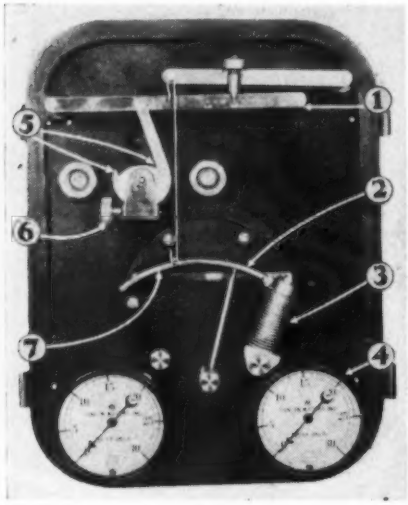
When you have an application requiring metal hose or tubing, regardless of its nature, we invite you to "go American." For in the American line there's one than can probably help you do the job just a little bit better. Our Technical Department will gladly assist with your particular problem.

AMERICAN METAL HOSE BRANCH
OF THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada:
Anaconda American Brass Ltd., New Toronto, Ont.
432103

ANACONDA

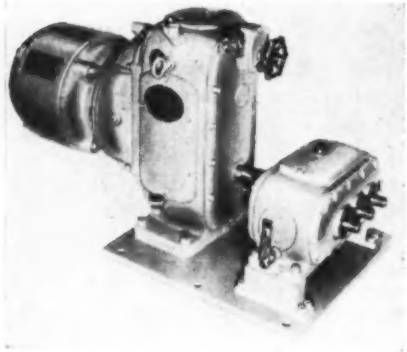
American Metal Hose

WHAT'S NEW IN PLANT EQUIPMENT



Lever Control Pilot

H-W TYPE 1410 lever-control pilot meets requirements for a unit having wide throttling range, important for indicating or recording level where displacement float is used to show level in vessels containing highly corrosive liquids. It has the following advantages, according to manufacturer: (1) specific gravity index scale setting from 0.10 to 2.0, (2) wide throttling range from zero to 300%, setting in exact relation to specific gravity setting, (3) long-life bellows, operating throttle arm, (4) straight-line pilot characteristic of pressure output to diaphragm versus level variation, (5) simplified reversibility, (6) adjustment for height of level control, (7) "snap-action" settings on pilot without additional parts or special tools. *Hanlon-Waters, Inc, National Bank of Tulsa Bldg, Tulsa, Okla.*

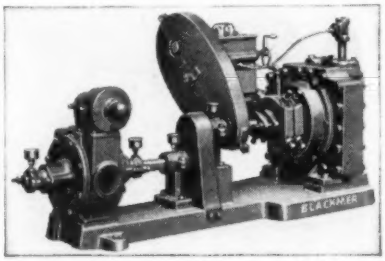


Test Rig

PHOTOGRAPH SHOWS one of the latest PIV gear variable-speed test rigs, arranged on a drilled flat steel base as a portable unit for testing vibrators, pumps, instruments, etc. Vertically mounted 2-hp motorized PIV gear, of 6:1 over-all speed range, is connected to a helical gear box having three output shaft extensions for testing, and a fourth extension for connection to tachometer. Three output shafts in line have speed ranges of 600 to 3600, 300 to 1800, and 150 to 900 rpm. Speed range of shaft extension for tachometer is 150 to 900; triple-scale indicator is for three speed ranges. Each shaft speed varied by turning hand regulating wheel. Larger hand wheel operates unit's vernier control. *Link Belt Co, 307 N Michigan Ave, Chicago, 1, Ill.*

Pumping Unit

UNIT DEVELOPED for handling gasoline and oils where electric power is not available. Engine operates with either steam or compressed air and is connected to pump through single-reduction gears. Pump, gearing, engine and



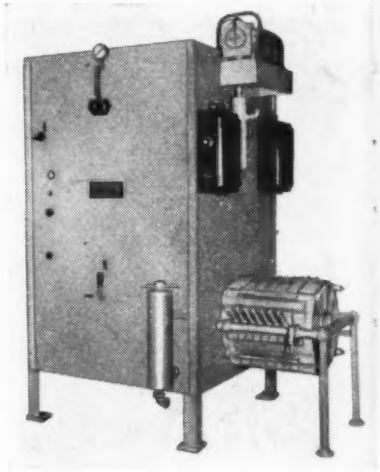
controls are mounted on common bedplate. Pump is iron fitted, has capacity of 50 gpm at 76-psi and speed of 460 rpm. Engine is 3 hp at 700 rpm. *Blackmer Pump Co, Grand Rapids, 9, Mich.*

Automatic Stop Valve

AUTOMATIC STOP VALVE is for use on air- or gas-pressure lines, where danger of fractures or leakage resulting in pressure loss or damage exists. Automatically shuts off flow when pressure falls to a preset point. Must then be manually reset before flow can be resumed. Can be operated on rate of flow, differential pressure or direct static line pressure. Extremely wide rangeability; a 300-psi valve may be set to operate at any pressure from 5 to 300 psi. Stop point is established by merely presetting desired shutoff pressure in the dome. *Grove Regulator Co, 65th & Green St. Oakland, 8, Calif.*

Fire Shield

FOAMITE FIRE SHIELD, 79½ x 75¾ in., is built of sheet steel, reinforced with angle iron. Between front and back plates of shield is an insulating-mineral wool blanket, said to withstand temperature of 1200 F. Three observation ports and four nozzle ports are each equipped with pivoted cover doors controlled from rear of shield. Anchoring chains provide for securing playpipes. At base of shield three hinged skirts give way over uneven ground. *American-LaFrance-Foamite Corp, Elmira, N. Y.*



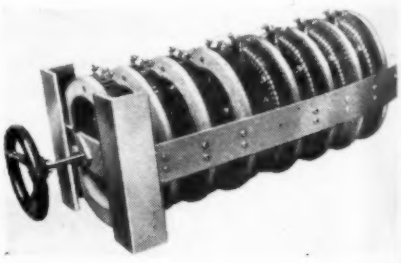
Oil Purifier

WHILE PRIMARILY DEVELOPED for purification of aircraft-engine lubricating oil, Hilco Airline oil purifiers find wide application in purification of other types of oil. Operation of Models A-50, 75, and 100, consists of drawing batch of oil to be purified into heater tank, into which is also introduced Hilite, fuller's earth or activated clay. Mixture is agitated and heated, then dropped into a rundown tank, and by compressed air forced into a filter press. Passage through secondary filter press assures removal of all solids. Unit illustrated has capacity of 50 to 65 gal per batch per hr. *The Hilliard Corp, 342 W 4th St., Elmira, N. Y.*

Tandem Rheostat Assemblies

TANDEM UNIT illustrated, consisting of eight Ohmite Model U, 100-watt, 12-in.-diameter rheostats mounted in steel

(*Continued on page* 170)



Coming Soon from Crane!

2 New Training Aids for Piping Men

1 "PIPING POINTERS" SOUND FILM

2 COMPREHENSIVE "PIPING POINTERS" MANUAL

HOW TO GET THESE FREE CRANE SERVICES

As soon as the "Piping Pointers" film is ready, your local Crane Branch will gladly arrange a showing in your plant at the most convenient time. The manual will be distributed to all viewers. Reserve your place in the showing schedule by calling your Crane Representative today.

VERY soon, your maintenance workers will get the benefit of this "Piping Pointers" sound training film. It will help them quickly grasp the fundamentals of piping—help them keep valves, fittings, and pipelines on the job—now when replacements are so hard to get.

Making this film doubly effective is a new Crane "Piping Pointers" manual—believed to be the most complete and practical booklet of its type ever compiled. In the film, trainees will see and hear a large part of the manual's contents actually applied. In its pages, they will find a lot more valuable "know-how" data that comes from Crane Co.'s 88-year experience as the world's leading valve and fitting maker. Crane Co., General Offices: 836 South Michigan Ave., Chicago 5, Ill.

"PIPING POINTERS" BULLETINS are still available—as long as present supply lasts. Introduced in 1941, this service is giving effective aid to piping men in countless plants.

CRANE VALVES

Mechanic . . .

Sure, I worked in a machine shop for quite a while—I had to—but my folks taught me that it was something you don't talk about.

Why, he's nothing but a mechanic.

I heard both of these statements while I was in New England not long ago. Both were from so-called "blue bloods"—the persistent American remnants of the stiff-backed landed gentry. That attitude isn't particularly Yankee—I've seen it in all parts of the country from people who consider it unfashionable and ungentlemanly to work with your own hands.

Some of them are getting a rude pushing around these days. They've found their "quality" offspring with the fancy college degrees doesn't get the consideration from the draft board that some youngster from the other side of the tracks gets—because the kid from the wrong side knows how to build airplanes and isn't afraid of calluses and grease.

That's all as it should be. This country was built, lock, stock and barrel, by men and women who did all their own work. No successful pioneer ever operated with a valet and butler. The whole idea of social classes is particularly un-American, as many brand-new, war-made plant managers have discovered to their sorrow. You can't make a man work by high-hatting him—especially when he knows his job and knows you aren't too sure of yours.

It's time we went back to the old-fashioned method of making every man work his way up. A good mechanic is every bit as much a man as a good doctor or a good lawyer. He has just as much cause—maybe more today—to be proud of his profession.

Perhaps the best idea of the mechanic's importance comes from Egypt, where American workmen have been training native *fellahin*, the lowest of the low there. These people, about half the population, earned about 30 cents a day working like beasts on farms, and lived in fly-ridden huts. From them, the Americans have picked their recruits. They have paid several times the former day rate, and taught the *fellah* to be a clean, self-respecting citizen—a mechanic. He likes his new position and is proud of it—in the country with the world's oldest "civilization"!

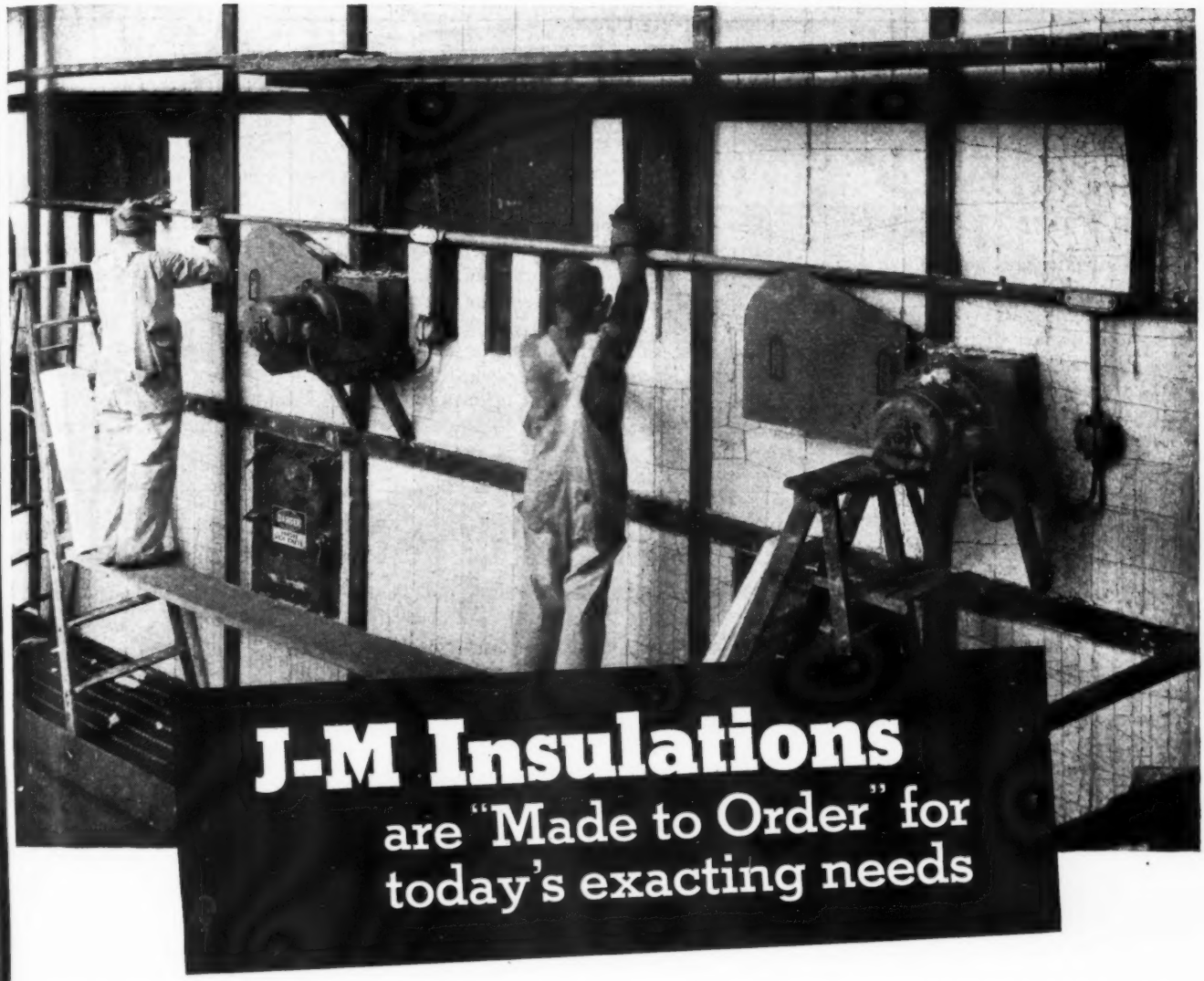
The American boss there gives a better definition of how to choose a man than any etiquette book ever developed. He says: "There are two kinds of guys—bright-eyed and dull-eyed. You can teach the bright-eyed anything, no matter where they come from."

The only thing I can add is that the bright-eyed guy also has a bright heart—the "git-up and git" today's world takes. He can afford to be proud of himself, because he's contributing something real and lasting to his world, regardless of his work.

George Edwards

Engineer

The man who works with his hands is a laborer.
The man who works with his hands and his head is an artisan.
But the man who works with his hands, his head and his heart is an artist.



J-M Insulations
are "Made to Order" for today's exacting needs

J-M Industrial Insulations cover every type of heat control. Each type of insulation is tailor-made to fit the particular job for which it was designed. In addition: Johns-Manville's 85 years' experience in every conceivable type of insulation problem makes it possible for J-M Engineers to design insulation applications for special conditions with utmost speed, thoroughness and economy. Following are just a few of the many types of J-M Industrial Insulations:

FOR TEMPERATURES TO 600° F. J-M 85% Magnesia has been for many years the most widely used block and pipe insulation for temperatures to 600° F. and, in combination with Superex, for higher temperatures. Maintains high insulating efficiency. Standard block sizes 3″ x 18″, 6″ x 36″ and 12″ x 36″; from 1″ to 4″ thick.

INSULATION FOR TEMPERATURES TO 1900° F. J-M Superex Blocks have long been standard for this service. High heat resistance, low thermal conductivity. Sizes 3″ x 18″, 6″ x 36″ and 12″ x 36″; from 1″ to 4″ thick.

FOR STEAM LINES UP TO 700° F. J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, high salvage and resistance to abuse are essential. For temperatures over 700°, used in combination with Superex. It is available in 3-ft. lengths, from 1″ to 3″ thick, for standard pipe sizes.

FURNACE INSULATION UP TO 2600° F. J-M Insulating Brick and Insulating Fire Brick are available in 7 types, with temperature limits ranging from 1600° F. to 2600° F. All provide light weight, low conductivity.

For details on these materials, and on the complete J-M Insulation line, write for Catalog GI-6A. Johns-Manville, 22 East 40th Street, New York, 16 N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville
INDUSTRIAL INSULATIONS
FOR EVERY TEMPERATURE... FOR EVERY SERVICE

POWER LINES

Personal notes, items of general interest, the latest from Washington — all the news that is news in the power field

Great Lakes Get More Water

Recently, the gate in one of the sluiceways was raised on the Ogoki diversion in the lonely wilderness of northwestern Ontario and water that normally would flow into Hudson Bay started on its way toward the Great Lakes. This unique $5,000,000 engineering undertaking, started in December, 1940, will divert an average of 4000 cfs from the Hudson Bay watershed into Lake Nipigon, down the Nipigon River into Lake Superior, through the Great Lakes and the St Lawrence River. The Ogoki water and that from Long Lake, a similar but smaller diversion 120 miles east, have a combined average flow of 5000 cfs and make possible the development of 360,000 hp additional between Lake Nipigon and tidewater on the St Lawrence. It is estimated that eventually these diversions will raise the level of the lower Great Lakes 2.25 in. For a more complete description of the project, see January, 1943 POWER, page 14.

Costa Rica's largest hydro-electric power development, about 25 miles from San Jose, is the fourth to be built on Virilla River. The new station will have an initial capacity of 5000 kw and ultimately 10,000 kw, which will add nearly 50% to the power developed on the river, the country's present chief source of electric power. Costa Rica now has a total of 18,000 kw of hydroelectric capacity and a few small steam plants.

Compania Nacional de Fuerza y Luz, San Jose, a subsidiary of American & Foreign Power Co, New York, is building this $1,750,000 project, largest power development between Mexico and Panama. It includes a horseshoe shaped tunnel 8700 ft long, with a minimum diameter of 8 ft, a large surge tank and two 5-ft diameter steel penstocks 800 ft long that lead the water to two Francis turbines in the power plant, each connected to a 2500-kw generator. Total static head at the plant will be 310 ft and the net head, with two turbines operating, 293 ft; four turbines 271 ft. Turbines and generators were manufactured in the U. S.

Steel-pressure pipe and tubes and other types of steel pipe now have standard specifications established by

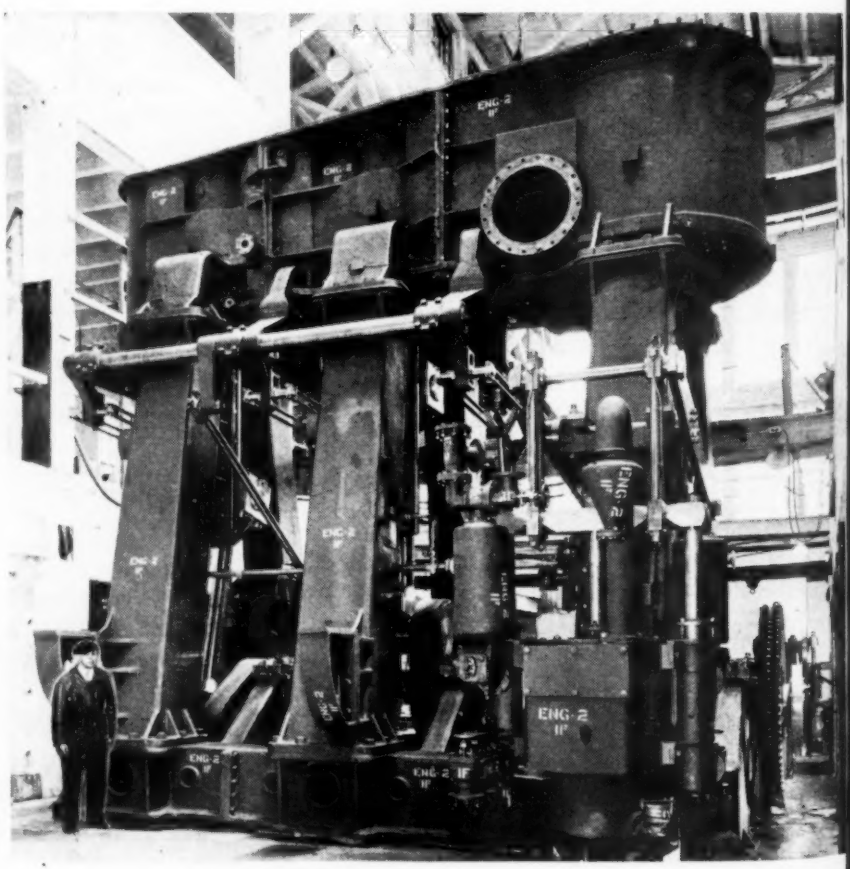
(*Continued on page* 190)

A 128-kv transmission line of 75 miles between Portsmouth and Trenton, O. will save power losses estimated at 20,000 kw. It is part of the 1945 power program of Office of War Utilities, which includes the following projects that OWU is expected to approve: (1) No. 4 unit at Kentucky Dam, a 32,000-kw hydro unit. (2) A 30,000-kw steam unit for the Bainbridge plant, N. Y. State Electric and Gas Co, Sidney, N. Y. (3) A 154-kv transmission line of 125 miles between Nashville and Watts Bar dam of TVA, which will also save 20,000 kw power losses. This line and the one above are aluminum. An additional 100,000 kw steam capacity for the north central industrial area will be approved and a site chosen. Thus far 1945 installations on the program finally approved total 147,000 kw, those on which approval is expected shortly total 182,000 kw. As much as 500,000 kw may be installed under the program.

New Engines for West Coast Liberty Ships

The triple-expansion engine in the photo weighs 270,000 lb. It stands 23 ft high, is 22 ft long, 16 ft, 8 in. wide and develops 2500 hp. Iron Fireman Mfg Co, one of the three largest builders of these engines in the U. S., builds 30 like it each month in their Portland, Oregon, plant. They have a stroke of 48 in. and cylinders ranging from 24½ in. in dia in the high-pressure cylinder and 37 in. in the medium-pressure cylinder to 70 in. in the low-pressure.

Iron Fireman furnishes all engines for Liberty ships built at Oregon Shipbuilding Corp and sends the surplus to other builders. When an engine is dismounted, it takes four flatcars to ship it. On Sept 15, U. S. Maritime Commission presented the Portland industrial division with a gold star for its "M" pennant. The company produces commercial and industrial coal stokers in its plants in Portland, Cleveland and Toronto. Besides marine engines, war production includes airplane parts, machine gun mounts and hundreds of army-ordnance parts.



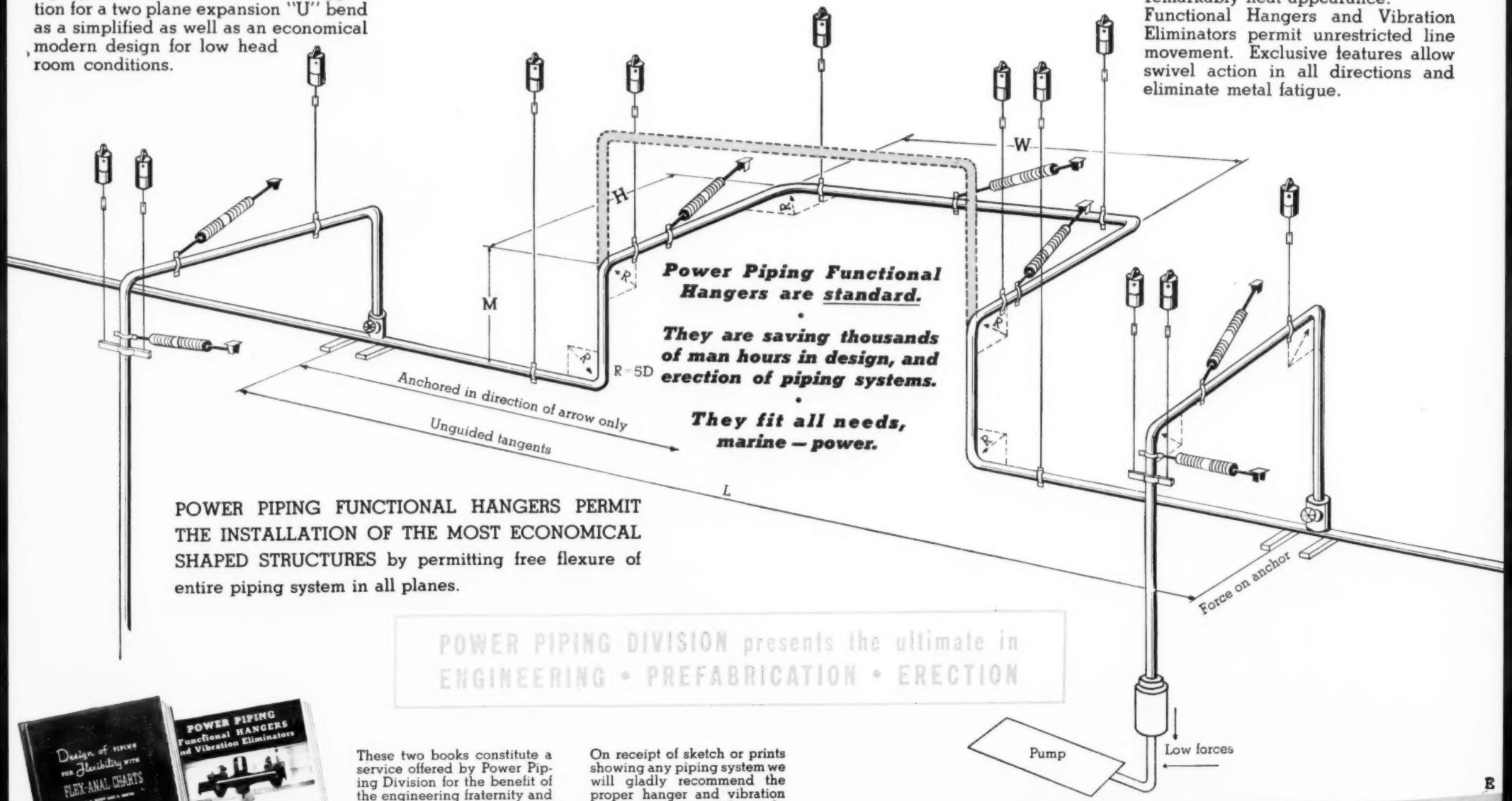
POWER PIPING SERVICE IS YEARS IN ADVANCE

POWER PIPING SERVICE IS YEARS IN ADVANCE

One example of "Scientific Approach to Piping Problems," illustrates a suggestion for a two plane expansion "U" bend as a simplified as well as an economical modern design for low head room conditions.

Spring assemblies are all of the same length at the same elevation away from interconnecting piping, valves, covering, etc., presenting a remarkably neat appearance.

Functional Hangers and Vibration Eliminators permit unrestricted line movement. Exclusive features allow swivel action in all directions and eliminate metal fatigue.



Power Piping Functional Hangers are standard.

•

They are saving thousands of man hours in design, and erection of piping systems.

•

They fit all needs, marine — power.

POWER PIPING FUNCTIONAL HANGERS PERMIT THE INSTALLATION OF THE MOST ECONOMICAL SHAPED STRUCTURES by permitting free flexure of entire piping system in all planes.

POWER PIPING DIVISION presents the ultimate in ENGINEERING • PREFABRICATION • ERECTION

These two books constitute a service offered by Power Piping Division for the benefit of the engineering fraternity and will be sent FREE to any engineer requesting them on his business letterhead.

On receipt of sketch or prints showing any piping system we will gladly recommend the proper hanger and vibration eliminator layout without obligation.

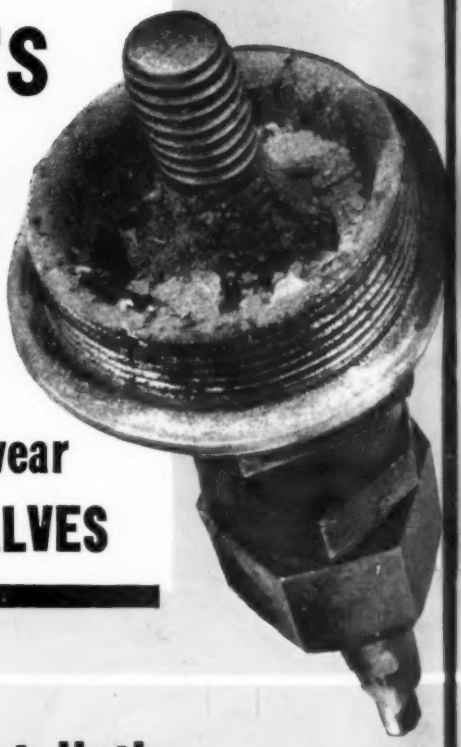
BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

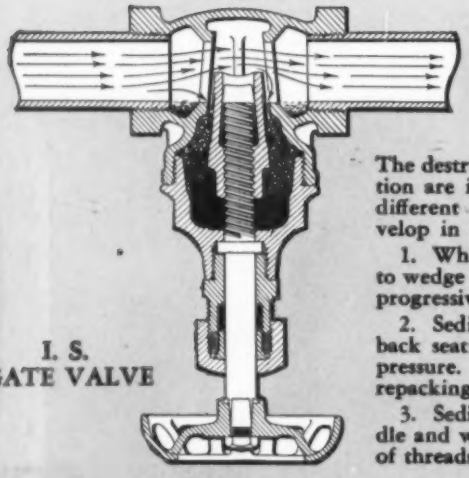
B

Prevent Valve Failure

Sediment smothers working parts...

speeds destructive wear in UPSIDE DOWN VALVES





I. S.
GATE VALVE

Why Inverted Installation starts Valve "Headaches"

The destructive results of upside-down installation are illustrated in these sketches for three different types of valves. Similar troubles develop in other types when inverted.

1. When closing valve, sediment may stick to wedge faces, prevent tight closing, and cause progressive damage to seat.

2. Sediment accumulation prevents complete back seating necessary when repacking under pressure. Line must then be closed while repacking.

3. Sediment accumulates in threads on spindle and wedge, causes sticking and rapid wear of threads.

4. Bonnet becomes a sediment collecting chamber.

5. Sediment and liquid, seeping down between body and spindle, causes scoring and rapid wear of spindle.

6. Seepage through packing box of O. S. & Y. valve affects operating threads on spindle, causing seizure and destructive wear.

7. Foreign matter lodging on disc face of a globe valve prevents tight closing and accelerates disc wear.

8. Packing deteriorates rapidly and leakage affects spindle and handwheel.

JENKINS VALVES

before it starts!

Plan Upright Installations of Valves for Trouble-Free Operation—Longer Life

Valves have no "upside-down stomach" to digest and dispose of destructive sediment. Because most valves are designed for upright installation, the inverted position invites a wide variety of troubles — sticking, incomplete closure, rapid wear, leakage, and eventual failure.

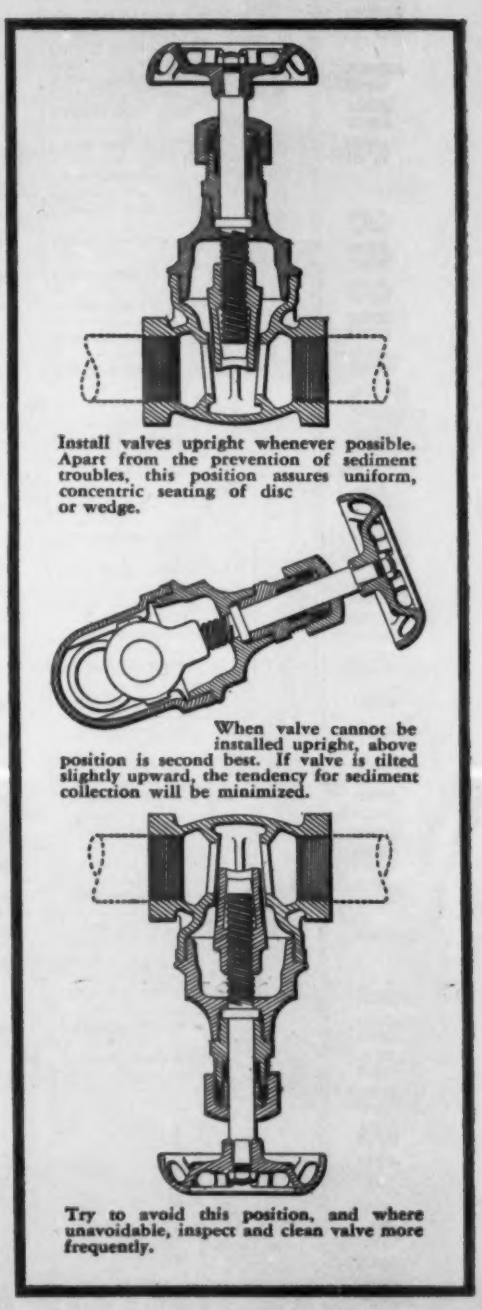
To make sure of efficient and trouble-free operation, plan upright installation for every service, and turn up valves in present use wherever possible. When it is absolutely necessary to invert a valve, be sure it is the type best suited for such conditions, and give it frequent attention. In the case of larger valves, provide a drain or suitable clean-out for blow-off purposes.

Production delays due to valve failure retard the delivery of vital supplies needed to "back the attack". Victory is slowed up, casualties increased. Many such failures can be prevented.

Install valves properly, after careful selection of the proper type for the service. Give them regular, systematic inspection. Repair or replace worn parts. Instruct maintenance workers thoroughly.

Jenkins Engineers will provide any assistance you need for improving your system of valve conservation.

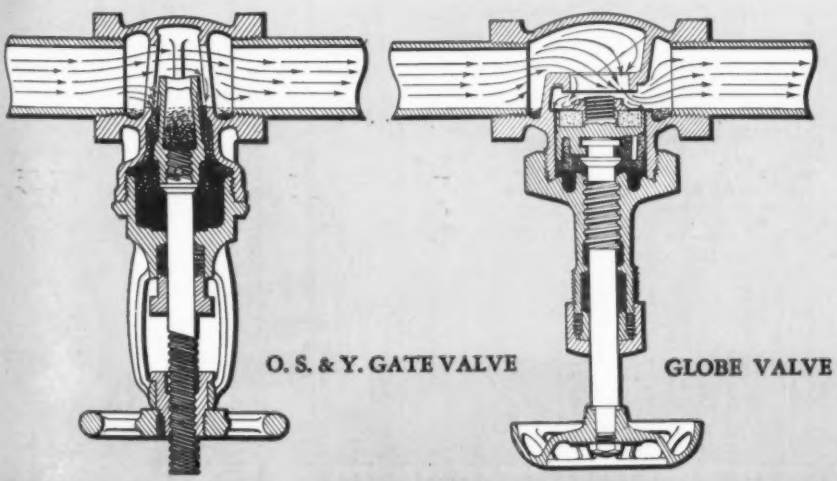
Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.



Install valves upright whenever possible. Apart from the prevention of sediment troubles, this position assures uniform, concentric seating of disc or wedge.

When valve cannot be installed upright, above position is second best. If valve is tilted slightly upward, the tendency for sediment collection will be minimized.

Try to avoid this position, and where unavoidable, inspect and clean valve more frequently.



O. S. & Y. GATE VALVE

GLOBE VALVE

For every industrial, engineering, marine and power plant service

BRONZE ★ IRON ★ STEEL

Fluorescent Lamp Troubles, Causes and Remedies

Chart prepared from data published by several fluorescent lamp manufacturers.

| TROUBLES | POSSIBLE CAUSES[1] | | |

DID YOU EVER SEE 5 BOILERS EXPLODE?

"Neither had we as we stood out of breath on the nearby hill, knowing that we had done everything possible to stop the fire. The frame structure that housed our five boilers was a mass of flames—there was only one thing left to do and that was 'scram.' We made the hill and we waited—there was one satisfaction to the boss—the boilers were insured. Still we waited and watched the flames play up and down the boiler stack. Out of the stack, as we could see through the flames, the smoke curled from the working boilers just as if nothing unusual were happening. Then all of a sudden there stood the five boilers—the frame exterior had crumpled to the ground—still the chimney smoked and we waited and waited."

This happened a good many years ago. The facts are in the insurance inspector's report. He credited the COPES Feed Water Regulators with saving these boilers. They continued to operate through smoke and fire after the crew had fled—they kept the water level safely above the tubes.

Dramatic, you say? We say this kind of protection is everyday performance for COPES on more than 65,000 boilers.

These are the facts given to our service man and to the insurance inspector.

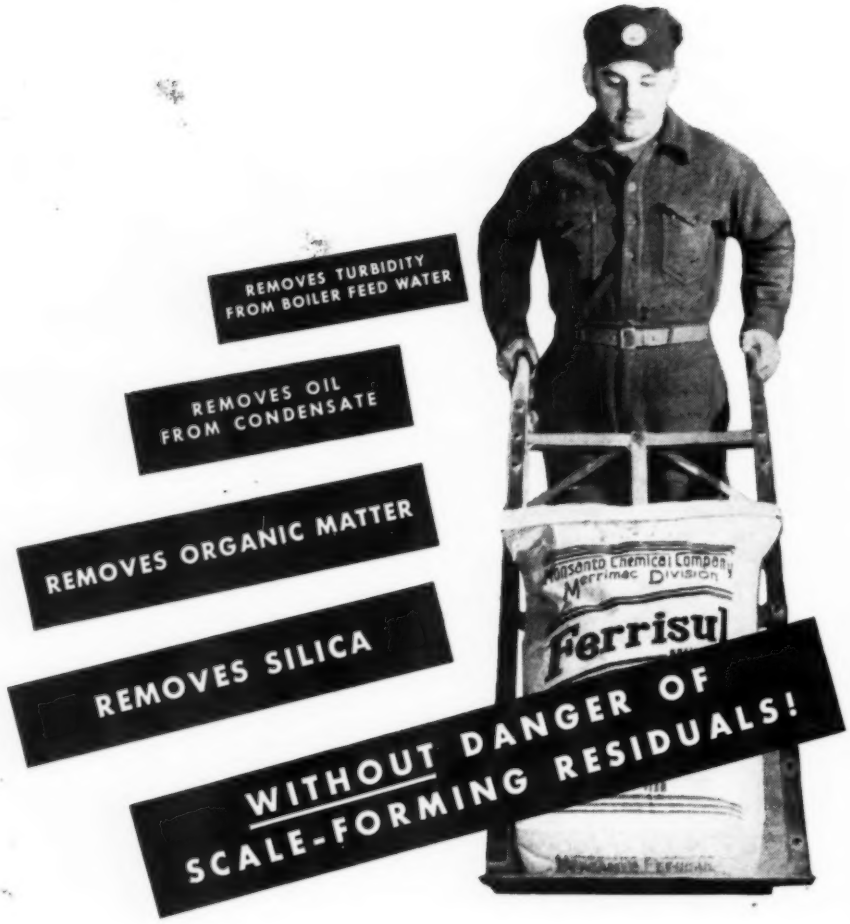
You will want to know more about the regulators that protect over 65,000 boilers. Write for general catalog.

NORTHERN EQUIPMENT COMPANY
1131 Grove Drive, Erie, Pennsylvania
FEED WATER REGULATORS • PUMP GOVERNORS • DIFFERENTIAL VALVES
LIQUID LEVEL CONTROLS • REDUCING VALVES AND DESUPERHEATERS
Branch Plants in Canada, England • Representatives Everywhere

OVER 60,000 COPES FEED WATER REGULATORS IN SERVICE

COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR



Here is one safe, sure, easy way to guard against power loss and plant damage caused by untreated or improperly treated boiler feed water — *treat with Ferrisul (anhydrous ferric sulfate)!*

Ferrisul rids boiler feed waters of silica and other enemies of heat transfer efficiency *without* leaving equally dangerous scale-forming or corrosive residuals. Its floc is highly absorptive, forms immediately, settles rapidly and is effective over the entire pH range above 3.5. It can be used in conjunction with either hot or cold process softening.

Dry and free-flowing, Ferrisul is easy to handle . . . requires no expensive storage tanks . . . can be transferred on any standard conveyor system . . . and can be introduced into the treatment in standard dry feed machines or solution feeders. Previous shortages have eased somewhat so that Ferrisul is again available to a limited number of new users. Write: MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston 49, Massachusetts.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND

Help! Prompt return of empty tank cars, carboys and returnable drums will help speed your *next* shipment of Monsanto chemicals . . . by helping to relieve critical shortages in shipping equipment.

Centrifugal Pumps

(*Continued from page* 69)

at a speed to develop 175-ft head at 150 gpm discharge. The original speed $S = 1750$ rpm, the original head $H = 214$ ft, and the required head $h = 175$ ft; then the new speed

$$s = \sqrt{175 \times 1750^2 \div 214} = 1582$$

rpm, say 1600 rpm.

After we have determined the speed for one point, by drawing a curve through it parallel to the original curve we have the head-capacity characteristics of the pump at the new speed. Calculations can also be made for more than one point on the new head-capacity curve, and the curve drawn through these points. If the pump speed can be readily changed, then it may be adjusted to give the desired flow without any other consideration.

The centrifugal pump is a flexible machine adaptable to a wide range of heads and capacities by throttling, change in speed or impeller diameter, or a combination of these as this article outlines in a general way. Of course, the pump manufacturer or his representatives are always available for consultation.

Wartime Boiler Operation

(*Continued from page* 71)

It is important that a qualified welder do the work, and many plants can justify keeping on the payroll a competent welder, who may be developed from a skilled mechanic. When it is not feasible, make arrangements at the most convenient source for emergency work by a qualified welder. *Qualified* is used in a limited sense because to meet Code and State inspection requirements, a welder must prove his ability by meeting a standardized series of tests. They are repeated periodically and if successfully met, the welder may continue to be classed as qualified.

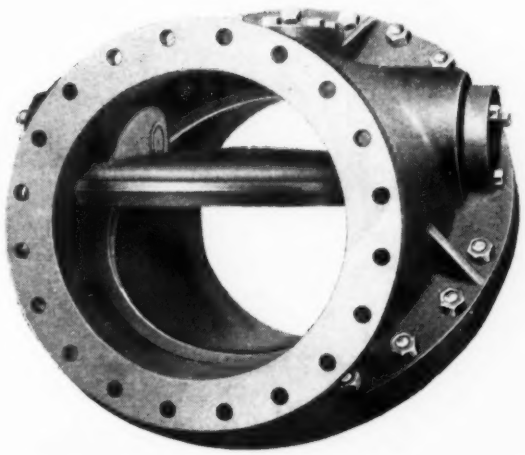
For this time-saving method of making tube repairs have on hand spare lengths of straight tubes of various sizes and thicknesses, not only for waterwalls but for superheater and economizer. Forming the welding groove at the tube ends usually proves simple, as practically all plants have some sort of a machine shop. As with spare tubes, supply of backing rings should include sizes suitable for every diam-

REASONS WHY Power Plants Choose Chapman Tilting-Disc Check Valves

Among the exclusive advantages of this unique type of check valve, these are the headliners:

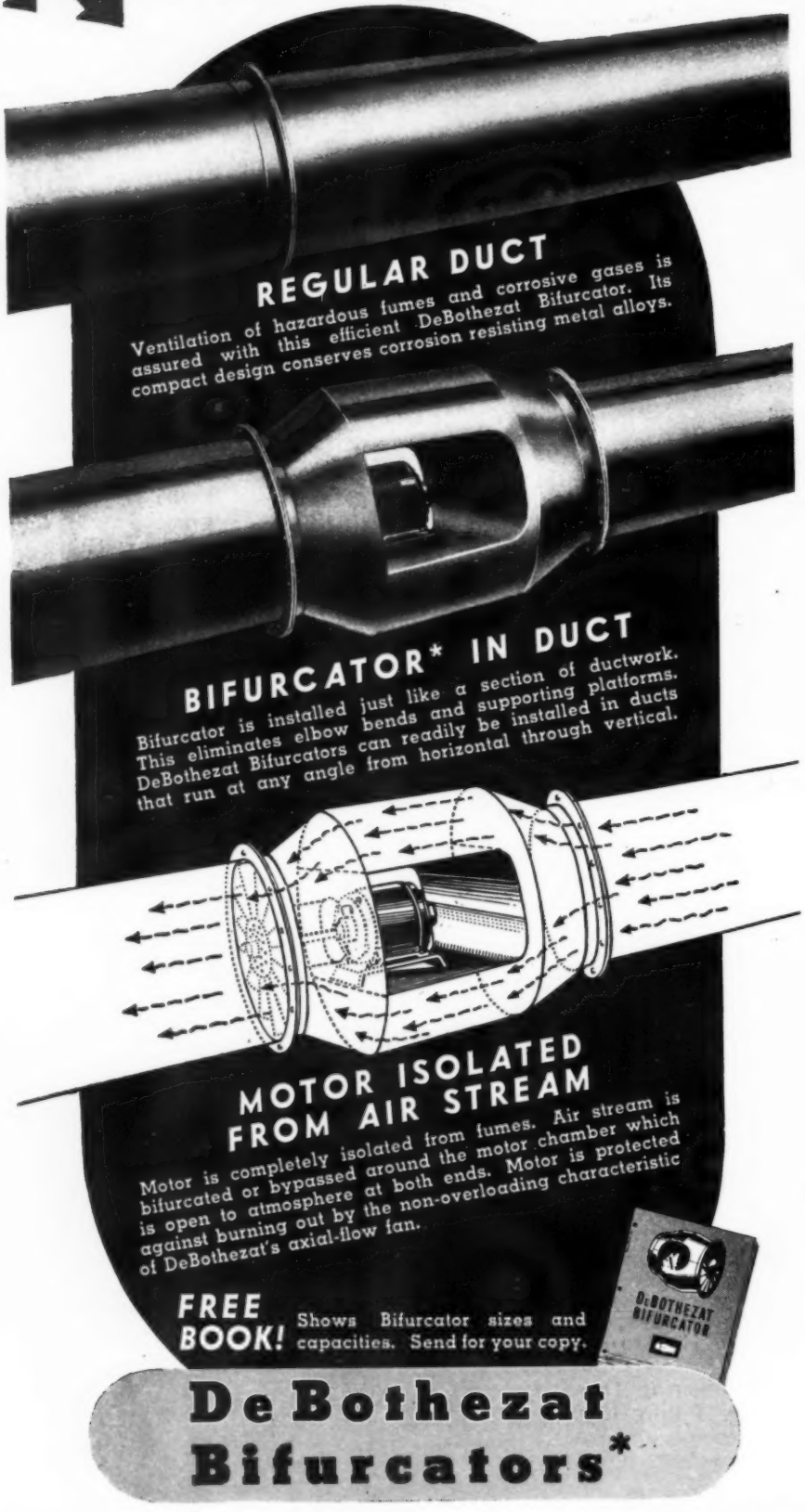
1. *No damage to pipe lines* . . . because the tilting-disc can't slam. It closes quickly and silently because the flow cushions the short flap of the disc.
2. *Valve-maintenance is cut to the vanishing point* . . . because the disc does not flutter in the flow, hence causes little wear on hinge-pins and bearings.
3. *Head loss is cut 65% to 80% over conventional type checks* . . . which increases pipeline capacity, also delivers greater power savings where valves are installed on pump discharge lines.
4. *Horizontal or vertical installation is equally efficient* on water, steam, oil, gas, and air lines.

Send today for Chapman's illustrated Engineering Data Book which gives full information on how Tilting-Disc Check Valves will improve your plant operation and cut your costs far beyond ordinary swing-type checks.



The **CHAPMAN VALVE** Mfg. Co.
INDIAN ORCHARD, MASS.

This DIFFERENT TYPE VENTILATING UNIT* installs in the Duct


REGULAR DUCT
Ventilation of hazardous fumes and corrosive gases is assured with this efficient DeBothezat Bifurcator. Its compact design conserves corrosion resisting metal alloys.
BIFURCATOR* IN DUCT
Bifurcator is installed just like a section of ductwork. This eliminates elbow bends and supporting platforms. DeBothezat Bifurcators can readily be installed in ducts that run at any angle from horizontal through vertical.
MOTOR ISOLATED FROM AIR STREAM
Motor is completely isolated from fumes. Air stream is bifurcated or bypassed around the motor chamber which is open to atmosphere at both ends. Motor is protected against burning out by the non-overloading characteristic of DeBothezat's axial-flow fan.
FREE BOOK! Shows Bifurcator sizes and capacities. Send for your copy.
DeBothezat Bifurcators*

DE BOTHEZAT DIVISION of AMERICAN MACHINE AND METALS, INC., EAST MOLINE, ILLINOIS

eter and thickness of tube in the unit.

This repair method is accepted universally except in a few isolated districts, and management should learn the local rules through its insurance company. Local insurance or state inspectors will furnish a copy of "Rules for Repairs by Fusion Welding to Power Boilers," published by the National Board of Boiler and Pressure Vessel Inspectors. Or a copy may be obtained from C O Myers, secretary-treasurer, Room 1105, 145 N High St, Columbus, Ohio. The local inspector should be consulted regarding general preparations for this repair method. He will also inspect the repair as it progresses and pass upon it before the boiler goes back to service.

Motor Maintenance

(*Continued from page* 89)

usually lightly loaded and require practically no maintenance, but should be inspected regularly to insure satisfactory operation. Upper guide bearings are required only with Kingsbury or flat-roller thrust bearings.

Alignment. Vertical motors are provided with a base having a machined lower surface; when required, a rabbet fit is also furnished. Do not use these parts for alignment unless the shaft alignment is checked to insure accuracy because the motor base is not always concentric and square wth the shaft.

Check the coupling alignment of a vertical motor the same as a horizontal machine. When the motor has a hollow shaft, check alignment of the inner with the hollow shaft to make certain that excessive bending moments will not be produced in the coupling at the motor's upper end.

Machines out of service. When shut down for an extended period machines require special care. If possible, keep the room dry and warm to prevent condensation of moisture on the windings. Lift brushes off collector rings and coat rings with paraffin or rust-resisting compound. Carefully remove this coating and lower the brushes on the rings before starting the motor again. Inspect journal and bearing surfaces frequently and keep them coated with heavy oil to avoid rusting.

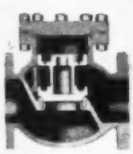
After an extended shutdown, thoroughly inspect and clean a machine before starting it. Remove all grease from the collector rings and if necessary polish. Measure the insulation resistance to determine whether drying out is required.

Some Other EDWARD Valves

GLOBE VALVES

ANGLE VALVES

INTEX VALVES


CHECK VALVES

RELIEF VALVES

NON-RETURN VALVES

HYDRAULIC VALVES

BLOW-OFF VALVES

PROTECT DELICATE PARTS with Edward Strainers

EASILY DISASSEMBLED, EASILY CLEANED

Keep dirt, scale and foreign matter away from the delicately adjusted working parts of traps, pumps, pressure regulators, air motors and valves with Edward forged steel strainers.

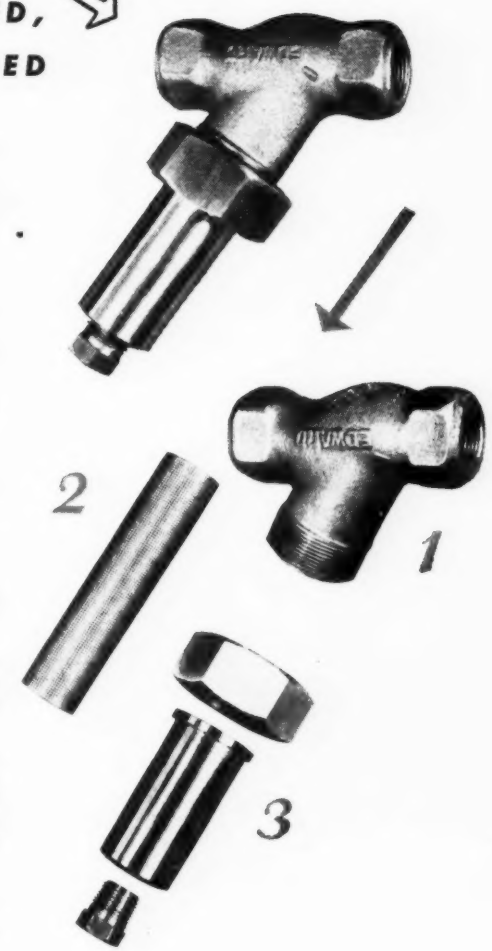
For steam, oil or vapor service up to 600 lb at 850 F or for hydraulic service up to 1440 lb at 100 F, Edward strainers may be installed in either horizontal or vertical lines.

Extremely easy to clean, Edward strainers may be blown out simply by removing the drain plug, or they may be disassembled quickly with ordinary tools to remove and clean the Monel strainer screen. Functionally designed, they have few working parts.

1 Forged steel body with streamlined internal body contours for free flow and minimum pressure drop.

2 Rustproof Monel metal perforated screen to withstand severe abrasive service, carefully fitted to prevent leakage of foreign matter around or under screen.

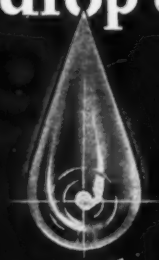
3 Steel union ring and bonnet make tight connection with body and hold screen firmly in place. Drain plug easily removed to clean out accumulated matter. Built in ¼ in. to 2 in. sizes with screwed or socket ends. Write for Edward BETTER VALVES Catalog No. 101.



THE EDWARD VALVE & MFG. CO., INC.
1220 W. 144th STREET • EAST CHICAGO, IND.

EDWARD *Steel* VALVES

Just a drop of water-



harmless···

or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

WATER CONDITIONING SYSTEM

TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

For your own satisfaction, investigate the new TECHNICAL System . . . Nature's own conditioning method developed under actual industrial operating conditions. Without obligation the coupon below will bring you the facts.

WATER TREATMENT COMPANY OF AMERICA

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☐ Please send the new Technical System bulletin.
☐ Have a Water Treatment Company engineer call.

Name _____ Title _____

Company _____

Address _____

Electron Tubes

(*Continued from page* 106)

wood, plastics and processing of foods.

In induction heating, he explained, the part is placed in or adjacent to a water-cooled inductor coil which carries a high-frequency alternating current. The magnetic field thus produced induces a current in the surface of the part and causes it to be heated. This heat is generated entirely in a surface layer, the depth of which is determined by the frequency used.

On the other hand, in dielectric heating the material is placed between two plates, thus forming a capacitor; a high-frequency voltage is then applied and considerable power in the form of heat is distributed throughout the material being treated.

Mr Jordon went on to point out that since induction heating permits its concentration on the surface of sharply defined areas, it is invaluable in the surface hardening of gears, bearings and other parts subject to surface wear. In the brazing field, the main advantages are uniformity of results and automatic operation, independent of the operator's judgment. In the dielectric field, the gluing of plywood and the preheating of plastics are the major applications to date.

Electronic Control

E H Alexander stated that no single industrial electronic development has contributed more to war production than resistance-welding control. Precision timing and heat control make it possible to fabricate many new and special metal alloys.

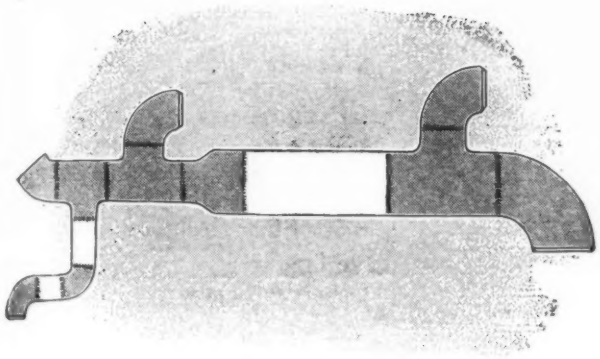
The increased use of aluminum alloys, especially in heavy gages, has brought forward the energy storage method of resistance welding to supply the very high currents required by these materials. In this system, an electronic rectifier takes power from ac lines and converts it to dc which is stored, usually in capacitors.

Without a single moving element, except the electromagnetic relay, electronic timers afford an accurate, simple and readily adjustable solution to the process-timing problem. Life of the equipment is measured in terms of tens of millions of operations, whereas two million without repair or adjustment would be an exceedingly long life for a mechanical timer.

"Perhaps the best known electronic control is the photoelectric, whose manifold applications to countless industrial

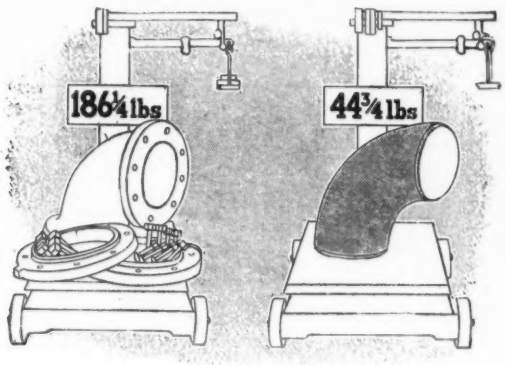
NO. 10 OF A SERIES
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY
The FIRST SEAMLESS WELDING FITTINGS

Improve industrial piping always with Tube-Turn welding fittings!



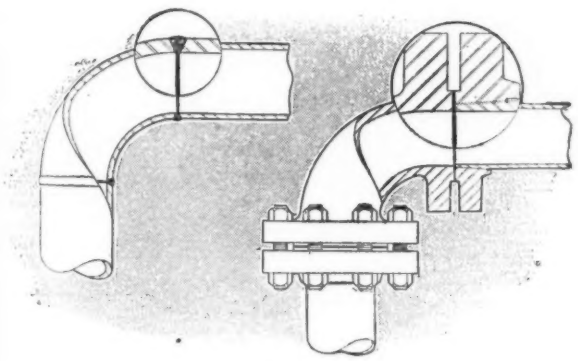
1. Easily preassembled—speed installation

Save from 50% to 75% time by pre-assembling difficult piping sections like this in the shop. Tube-Turn fittings are ready to use. They simplify lining-up, require only easy, circumferential butt welds. This insures faster, better and safer welding by either veteran or novice welders—a real war production help.



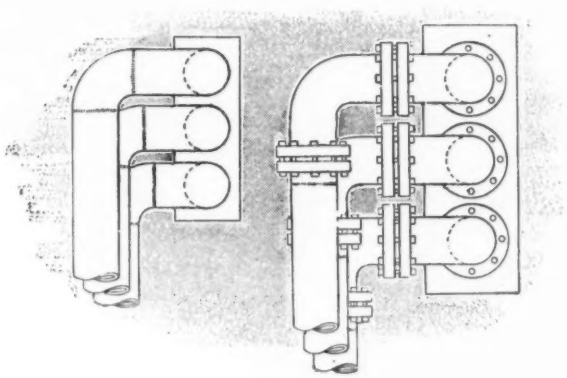
2. Reduce weight—conserve materials

Look at the weight saved by using an 8" Tube-Turn elbow instead of a heavy 8" cast iron flanged ell with companion flanges, studs and nuts. Multiply this saving by the many fittings in any piping system and it's easy to see how Tube-Turn fittings save tons of weight, metal and critical materials.



3. Avoid "down time"—reduce maintenance

Note how the welded connection virtually forms a continuous tube without joints—insures permanently leakproof, trouble-free connections that last as long as the pipe itself! Such maintenance headaches as leaks, gasket changes, bolt tightening, caulking, threading, and difficult insulatings are totally eliminated.



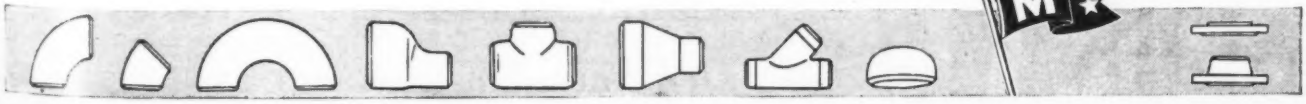
4. Streamline systems—save space

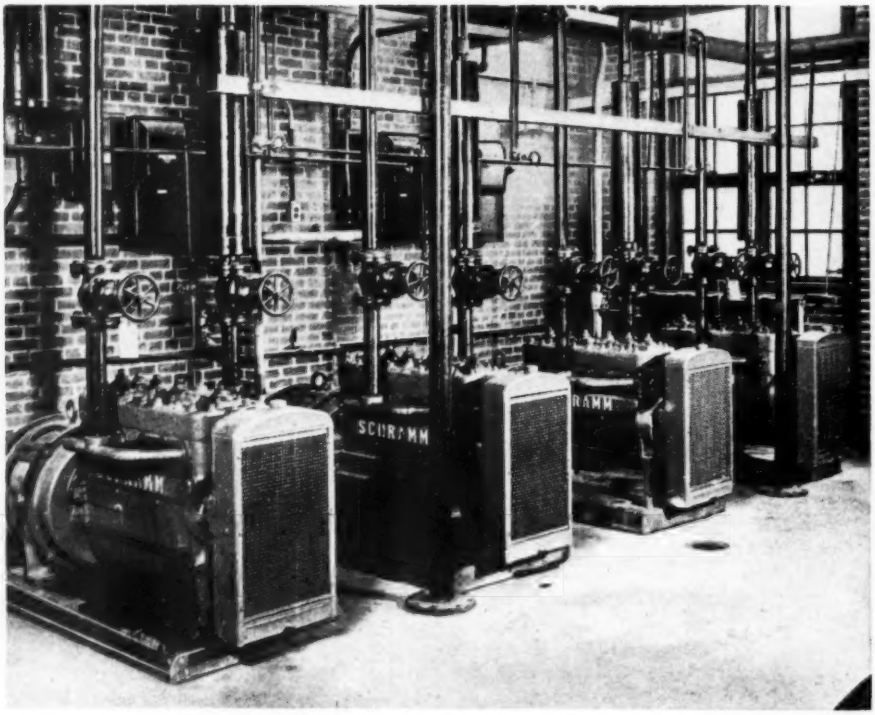
Contrast the space saved in these compound turns by using Tube-Turn elbows instead of flanges. Tube-Turn fittings require less space, permit streamlined, compact layouts and neater, more efficient piping. Elbows can be cut to any odd angle. Saving space is important in most industries, is vital in shipbuilding!

TUBE TURNS (INC.) Louisville, Ky. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle. *Distributors in principal cities.*

TUBE-TURN *Welding Fittings and Flanges*

Buy another War Bond this week!





Lots of Power...

BUT EASY TO HANDLE!

Here's four of a battery of #210 cu. ft. actual air Schramm Compressors, operating as a unit system for a large industrial plant. They're taking care of the variable maximum and minimum load, automatically, 24 hours a day—*with minimum attention!*

Schramm was specified because it provides heavy-duty, continuous operation with least attention, upkeep and operating costs.

Schramm Air Compressors are available with various types belt drives, as well as built-in motor drive and direct connected diesel or gasoline engines. Each unit is lightweight, compact, with capacities up to 600 cu. ft. displacement.

Long-life features of Schramm include: mechanical intake valve ... vertical piston travel and horizontal valve action ... sturdy support for cylinder head ... and forced feed lubrication.

Other Schramm features are likewise outstanding. Write today for complete details in Catalog 42-S.

SCHRAMM INC

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

operations exceed those of all other industrial electronic devices in quantity and variety," said Mr Alexander. "To control a device or process without touching it, such as guiding a web of fragile tissue, counting freshly painted objects or sterile articles, or checking or regulating the temperature of a white-hot process, renders the phototube and its associated equipment a real industrial tool."

The phototube is playing a most important part in many high-speed processes, such as: (1) policing the printing of paper moving at 1000 fpm, to assure that all colors are in register, (2) detecting pinholes in steel strip moving as fast as 1000 fpm, (3) holding tension on loops of continuous web or strip of material being processed in different machines at high speeds, (4) holding steel strip in register as it is being coiled so that the coils will be uniform.

Welding Saves Tons

(*Continued from page* 91)

exceed one hour, and the cost in man-hours was about $2.30.

As an alternative to welding we would have had to cut one economizer tube bank off at both injection and exit headers, and weld blanks into the stub ends. This would have eliminated the leak, but would also have reduced the margin of extra economizer capacity. To cut out the tube bank and weld stub ends at the headers would have required an additional day's shutdown on boiler.

Cost of welded repair:	
Labor cost	$2.30
Shutdown cost on boiler for 38 hours	828.00
Total cost	$830.30
Estimated cost of alternative method:	
Labor cost	$18.40
Shutdown cost on boiler for 60 hours	1386.00
Replacement value economizer unit	295.00
Total cost	$1699.40

Repair to steam manifold: A forge-welded steam manifold, used as a distributing header for the main generating unit and steam-driven auxiliaries, developed leaks. With the header out of service, the whole generating station had to be shut down.

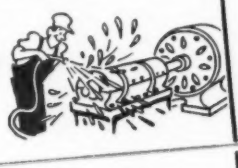
Extent of cracks was determined by

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

Have You a Tough Grease Problem?

HOW TO SOLVE Operating Problems with *Correct Lubrication*

JUST LOOK AT SOME OF THE OPERATING CONDITIONS SPECIAL GARGOYLE GREASES ARE LICKING. THE EXPERIENCE THAT DEVELOPED THESE GREASES IS AVAILABLE TO YOU...

HIGH TEMPERATURE	OVER 400° F.		Gargoyle Grease BRB4 Gargoyle Sovarex Grease
EXCESSIVE WATER	WATER-FLOODED BEARINGS		Gargoyle Grease AA Gargoyle Sovarex Grease
EXTREME SPEEDS	20,000 TO 50,000 R.P.M.		Gargoyle Grease BRB4 (for ball bearings)
HIGH PRESSURES	MEETS MOST SEVERE STEEL MILL USE		Gargoyle Grease Sovarex L
LOW TEMPERATURE	−40° F.		Gargoyle Mobilgrease Zero
WIDE TEMPERATURE RANGE	+250° F. TO −60° F.		[Name on Request]

IF YOU are responsible for the operation of any machines or equipment that are grease-lubricated—*be sure you've heard the Gargoyle Grease story!*

There is available to you the same full line...the same high quality in Gargoyle *Greases* that you have learned to depend upon in Gargoyle *Oils.*

And they are sold on the same basis i.e. *their use will bring you benefits in power and maintenance economies...and in full time, capacity production!*

GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC.—Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Magnolia Petroleum Co. • General Petroleum Corporation of California

HEADQUARTERS FOR GREASES TO MEET EVERY PROBLEM—

SOCONY-VACUUM

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

magnetic examination. Then they were chipped out and welded, Fig. 3. In addition to welding the cracks, weld-metal ties were added transverse of the crack to act as reinforcing straps. After repairs, the manifold went back in service and gave no further trouble until some weeks later when it was replaced with a new one.

Since there was no alternative to arc welding, no comparison can be made with any other method. The shortest estimated time for replacing this manifold was from 20 to 30 days. However, the savings effected by this temporary repair are important. They are approximated in the following:

Use value of the generating station for a 20-day period	$14,320.00
Cost of outage for repair, plus cost of repair.....	368.00

Although 20 days was the lowest estimate used to determine the outage cost of this job, it is probable that the time would have run much higher. It was necessary to design and fabricate the manifold under the Boiler Code, and this entailed heavy reinforcement of the necks and stress relieving the entire vessel, all of which adds to fabricating time.

Repairs to induced-draft fans: This was not strictly an arc-welded repair, but arc welding played such an important part in making the repair possible, and later in repairing the repair job, that description is warranted.

The steaming capacity of two boilers had been increased about 16% by improving boiler circulation and reducing slagging conditions in the furnace. This increased boiler capacity meant that auxiliaries had to carry more load.

Under the old ratings induced-draft fans, as they were then constructed, lasted about one year. Each time the boilers were down for general overhaul, the rotor blades had to be replaced or repaired in place. At the higher ratings the blades were dangerously eroded, Fig. 4, after a three-months' period.

Changing a fan rotor involves shutting down for at least eight days; this means that each of the two boilers would be down for fan changes three times a year, the fourth change coming during the general overhaul.

To increase fan-blade life, we decided to weld wearing plates of abrasion-resistant material onto the blades. A thin layer of hardsurfacing material was applied to an appropriately shaped thin plate, and this in turn welded to a rebuilt fan rotor.

Hard surfacing material was applied to the steel plates in such a manner as

Heavyweights
FOR HUSKY WORK

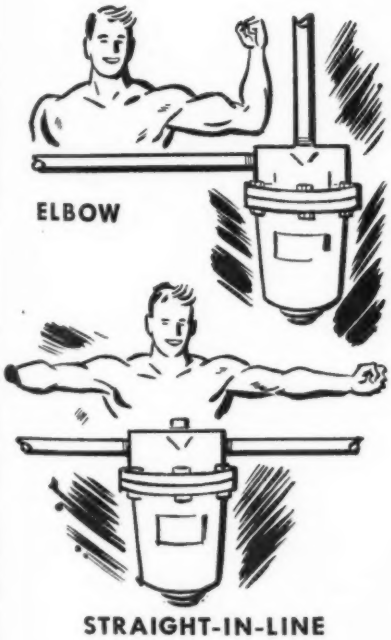
The three units of pre-fabricated piping shown here, together with the 8" 2500 lb. carbon moly flanges, aggregate approximately six tons. These heavyweights (1⅛" pipe wall thickness) are designed for use on operating pressures of 5400 p.s.i. This job required, among other operations, reinforced nozzle welding and circumferential butt welding–all handled by certified welders using modern pre-heating, stress-relieving equipment.

The character of this work gives clear perception of the full scope of service Associated offers in the field of industrial piping.

WAR PRODUCTION...This company is engaged in high priority war production, proud of its responsibilities and fulfilling them to the letter.

ASSOCIATED PIPING & ENGINEERING CO., INC.
2332 EAST 38TH STREET
LOS ANGELES, CALIFORNIA

LET'S STRAIGHTEN OUT these contortionists



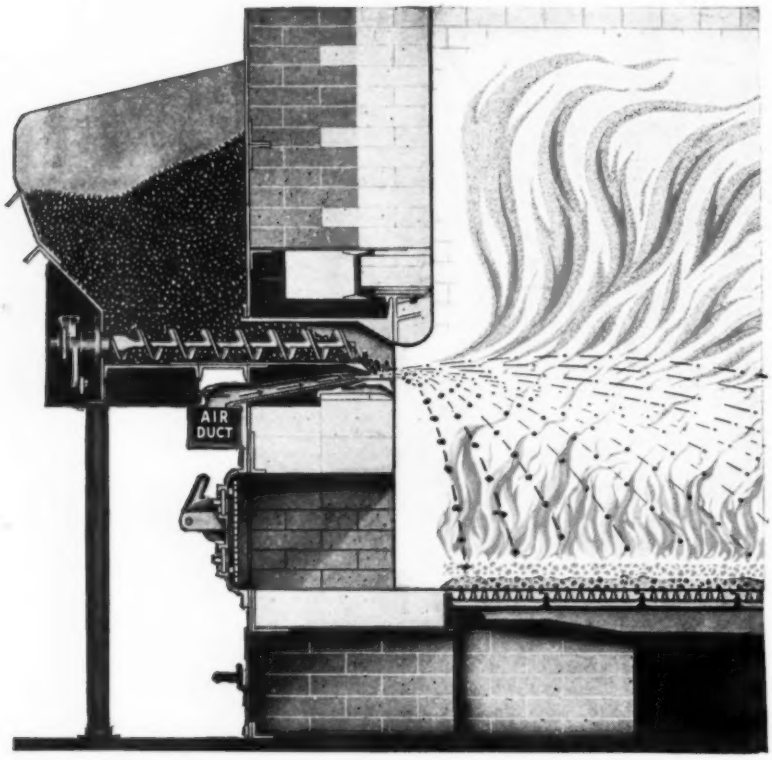
Years ago our steam trap piping frequently looked like the freak contortionist of circus and stage. Let's straighten out these contortionists in future steam trap piping by specifying and installing only ANDERSON SUPER-SILVERTOP STEAM TRAPS, the inverted bucket steam trap that can be piped straight-in-line or as an elbow . . . that doesn't require the purchase of extra fittings . . . that saves as much as an hour of installation time per trap. And with simplified piping, Anderson Super-Silvertop Steam Traps bring you greater condensate capacity, positive operation, ease of inspection and a longer service-life.

You can find out all about these advantages of Anderson Super-Silvertop Steam Traps by sending for a copy of the booklet, "How to Choose a Steam Trap," which is yours for the asking.

THE V. D. ANDERSON COMPANY
1934 WEST 96th STREET • CLEVELAND, OHIO

Super-Silvertop
STEAM TRAPS

Install the stoker that burns Local, Low-cost, Low-freight Coals!



DON'T penalize yourself with equipment that requires special high priced coal, when you can convert with FYR-FEEDER stokers that burn any kind of bituminous coal you have available locally—from 1½" screenings down to yard sweepings.

STEP UP PRESENT BOILER CAPACITY. WPB is granting priorities for FYR-FEEDER stokers to plants requiring additional steam generating capacity. In a great many cases these stokers make it unnecessary to add another boiler to handle an increased load. FYR-FEEDER features: suitable for large or small boilers . . . low maintenance . . . low power requirements . . . maximum active coal burning area (no dead plates) . . . easily accessible multiple feeding units . . . large hopper capacity . . . accurate over-fire air control . . . no clinkers (thin fuel bed).

QUICK DELIVERY

FYR-FEEDER stokers can be installed with minimum loss of production time, without major alteration to present boiler equipment. Made by a company that has specialized on overfeed and spreader stokers for 25 years. Widely used by nationally known concerns.

FYR-FEEDER MULTIPLE SPREADER STOKERS BURN COAL LIKE OIL

ASK FOR CATALOG illustrating operation, design and typical installations. Write today.

AMERICAN COAL BURNER COMPANY
ENGINEERS • ESTABLISHED 1918
Builders of thousands of industrial Stokers

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to reduce distortion and dilution of the hard material to minimum. Plates were then heated to 1700 F in a gas-fired furnace and straightened. After straightening, they were cooled slowly and then welded into place, with joining welds shaped to give best gas flow.

Because it was necessary to keep the plates as flat as possible during welding, it was not feasible to use arc welding for the original deposition of hard-surfacing material. However, other characteristics of the arc-welded deposit were superior to the method used and longitudinal cracks in the deposit were repair-welded with the arc, both in the new installation and in the fans, after service wear had shown bad spots. Arc welding is the only practical means of repair welding the hard surface deposits with the wearing plates installed in the fan rotors.

Although it was necessary to repair weld some of the hard facing that had been applied incorrectly on the first installation (except the few hours necessary to make this repair), the unit has been in service seven months and we feel that the rotors will need changing only once a year instead of four times. Costs of the two methods for one boiler are given in the panel on page 91.

Smokestack repair: Two stacks of steel at one station are not refractory lined. General corrosion throughout and especially at the lap-section joints had reduced metal thickness considerably. High system load prevented shutting the station down long enough to wreck the stacks and build new ones. We reinforced them by welding 3-in. angles longitudinally around the inside periphery at appropriate intervals. Lap-section joints were strengthened where necessary by annular channel sections welded above the joint, Fig. 1.

Obviously, welding was the only practical method. Riveting would have meant supplying cover plates for the internal angle bracing. Besides using more steel, this method would have required more time and expense for field layout and drilling rivet holes.

We estimate that the repair increased the useful stack life two or three years, which is important today.

Total cost for the three maintenance repairs, where cost analyses were made, represents net saving attributable to arc welding:

Cost of alternative method of repair	$34,419.56
Cost of welded repair	2,959.60
Saving	$31,459.90

The maintenance jobs represented in

Heat-Fag and Fume-Fag OUT!

Production Up, Workers' Skill and Morale on Top When You Put a Coppus Blower or Heat-Killer In!

Here, in the cool, fresh air circulated onto the job by a Coppus "Blue Ribbon" Blower or Exhauster, you'll find just what you were looking for —

A sure way to get the most from every man-hour . . . near furnaces . . . in tanks . . . underground cable manholes . . . in confined spaces . . . around hot processes.

Easily adaptable to a wide variety of purposes, every Coppus Blower and Exhauster is portable, and on each of them the "Blue Ribbon" is the sign of Coppus precision workmanship and trouble-free, long-lasting strength.

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 311 Park Avenue, Worcester, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG.

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- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
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- ☐ drying of walls, sheets; etc., after treated with coating material.

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CITY.....

(Write here any special ventilating problem you may have.)

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with

WELDOLETS • THREDOLETS

3 Types Meet Every Need

WeldOlets for butt welded branch connections.

ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type welded branch connections.

Cutting Main Pipe
WeldOlets and/or ThredOlets eliminate shaping the main pipe with a torch to install a branch outlet. Fittings are installed anywhere on the main pipe without the use of templets.

Shaping Branch Pipe
WeldOlets and/or ThredOlets eliminate the necessity of shaping the end of the branch pipe as when making pipe-to-pipe welded outlets.

Leaks
WeldOlets and/or ThredOlets eliminate the possibility of leaks; provide a junction of full pipe strength; reduce maintenance costs; eliminate costly shut downs for repairs.

Inspection
WeldOlets and/or ThredOlets permit inspection of the inside of joint after installation. They permit removal of slag and other scrap which might get into the system causing damage to costly valves and equipment.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line—and always with ease and economy. They are equally well adapted to prefabricated or "on-the-job" assemblies. Because of their patented, funnel-shaped intake aperture they improve flow conditions. Carried in stock for all standard pipe sizes up to 12" in size-to-size or reducing sizes—and can be furnished on special order in sizes up to 24". Stock fittings are drop forged steel, but to meet special conditions will be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for a copy today.

Forged Fittings Division
Bonney Forge & Tool Works, Allentown, Pa.

Star Awarded July 10, 1943

WELDOLETS • THREDOLETS

TRADE MARKS - REG. U. S. PAT. OFF.

Welded Outlets for Every Piping System

the figures given are only a few of the repairs involving welding which have saved considerable time and money. Almost every day jobs are welded which, if analyzed from a cost standpoint, show savings as remarkable.

Arc welding in maintenance repair used to be a last resort; today it is the first method to be considered, and it generally provides the answer.

Cooling Systems

(*Continued from page 74*)

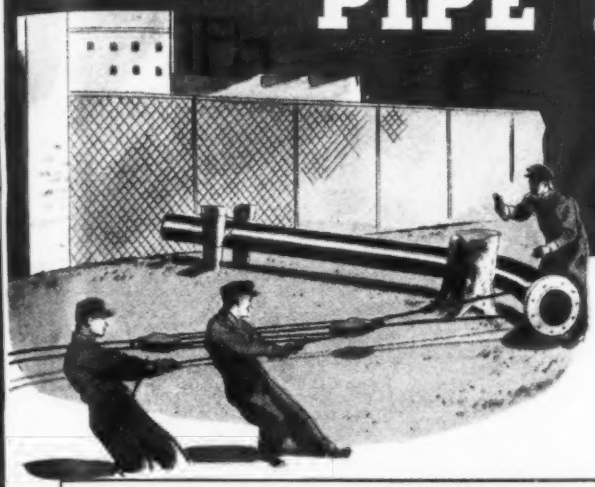
difference in average temperature is 22 F more for forced-oil-cooled transformers than for self-cooled ones and the heat-dissipation rate correspondingly greater. Consequently, on large transformers or heavily overloaded ones of smaller size, forced-oil cooling is the most economical, even though it requires power for the pump motors to circulate the oil. For many modern self-cooled transformers, forced-oil cooling makes practicable an increase in capacity up to 67%.

Forced-oil-cooled transformers have been used extensively in Europe, but seldom in the United States until the present war. Recently, many large ones have been constructed to conserve critical materials. Modern forced-oil cooling overcomes most of the older cooling systems' disadvantages, and its continued use after the war is probable.

Oil-immersed water-cooled transformers. These units are limited to locations having a constant supply of suitable cooling water. The cooling coils, made of copper pipe about 1 in. in diameter and placed inside the transformer tank, require only a small increase in space. These coils pick up heat from the oil and transfer it to the water circulated through them. Because heat transfer rate from oil to water runs several times that from oil to air, water cooling is efficient. It may be applied to any size transformers but shows a saving in cost over self-cooling only for units of about 2000-kva rating and above.

Refrigeration can provide a maximum amount of cooling. Since the oil can be held at a low temperature, the safe output of a transformer is greatly increased. The most practicable combination is forced-oil cooling and an oil-to-liquid heat exchanger that has its liquid cooled by refrigeration. Because first cost as well as operation and maintenance costs of refrigeration is high such cooling is not used for transformers.

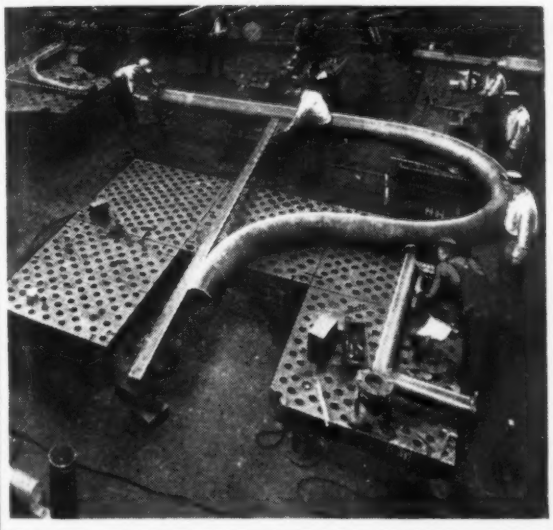
PIPE FABRICATION
Is Not a "Back Yard" Job



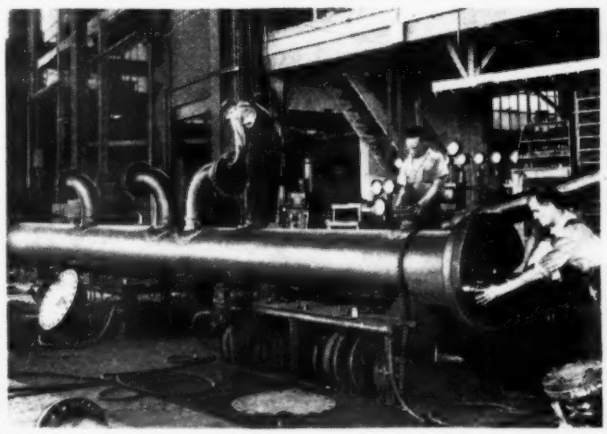
If pipe fabrication looks like an easy skill which can be picked up and practiced at odd times in the back yard, consider these facts: Qualified pipe fabricators report that it takes years to train skilled mechanics such as pipe benders . . . and years to develop competent piping layout men.

Expensive equipment is needed if a job is to be done satisfactorily and economically . . . layout tables . . . bending equipment . . . Van Stone machines . . . rotating fixtures and jigs for welding . . . furnaces for heat treating and stress relieving . . . machine tools . . . testing equipment . . . etc. A subassembly which looks relatively simple may require the use of equipment representing a very large investment.

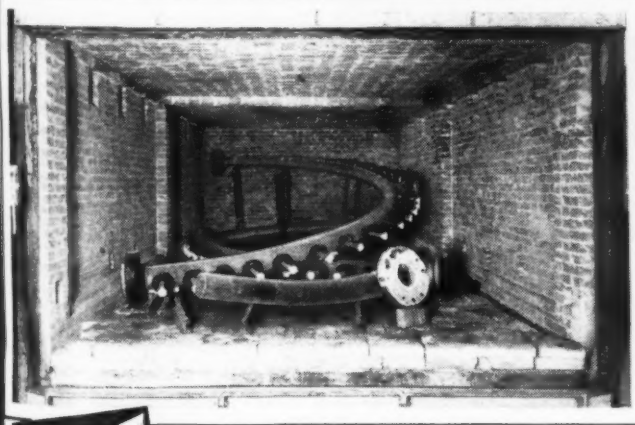
Pipe fabrication is not a back yard job—it is a difficult art which requires skill, special training, experience, and plenty of equipment. Qualified pipe fabricators have the well-equipped shops staffed with the highly skilled men necessary to meet today's exacting pressure piping requirements.



Layout and squaring tables used by qualified fabricators for more accurate piping.



Testing in the shop of the qualified pipe fabricator saves time in the field.



Furnace for heat treating alloy piping and stress relieving shop- welded subassemblies.

P.F.I. THE PIPE FABRICATION INSTITUTE

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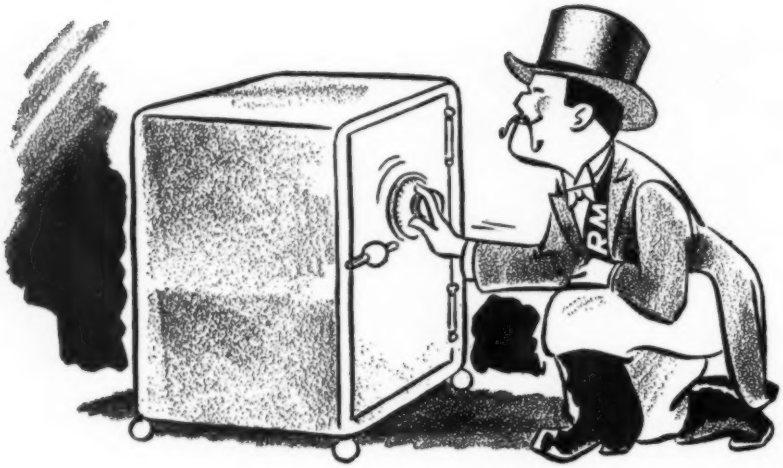
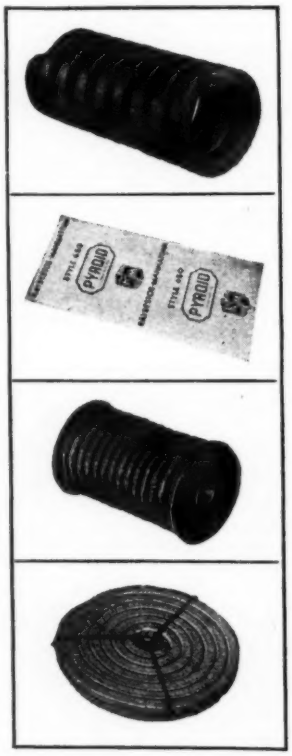
Use R/M Packings



Packings that stay put save time and money. And in these days of over-loaded and over-worked steam, oil, fuel, and air lines it takes the toughest packings you can get.

R/M Packings are built for war-time pressures. They make the material in your pipelines as safe as money in the bank. See your local R/M distributor for catalog and complete information, or write direct.

Awarded to R/M
North Charleston Plant



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MANHEIM, PA.
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Makers of Packings for Every Industrial Use

Coal Shortage

(*Continued from page 93*)

sumers who laid in stocks of coal when it was available are now finding it necessary to burn their stocks instead of receiving shipments for current needs on their contracts with producers," Administrator Ickes points out. "Perhaps they are not pleased with this necessity since the use of stocked coal instead of current deliveries may increase their current fuel bill perhaps 40 cents a ton. Nevertheless, it is one of the things which has to be done to meet the emergency.

"These consumers may console themselves with the fact that if it were not for the government stocking program and maximum prices the shortage of coal would be far greater and the price of any that could be bought would be two or three times as great as it is now."

The only other regulations for bituminous coal that have been promulgated by the Solid Fuels Administration, and are not concerned with distribution of coal for domestic use, deal with furnishing the Administration with the information it needs to enforce orders or keep check on existing supplies of coal.

Three Ways to Help

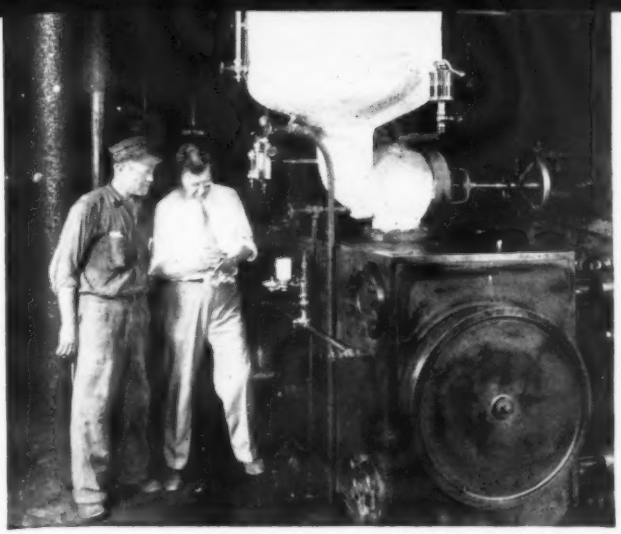
Administrator Ickes specifies three principal ways in which industrial consumers can cooperate with the Solid Fuels Administration in meeting the current emergency.

1. Consumers with large stocks will be called upon to share their coal with others who must have fuel to keep from closing down.

2. Consumers in a critical situation with respect to fuel should state their situation fully to the Solid Fuels Administration, giving all the pertinent facts, including the amount of coal they consume, the kind, source of supply, etc. The Solid Fuels Administration will make every effort to find them a satisfactory substitute to carry them through the period during which their regular supply of coal is inadequate.

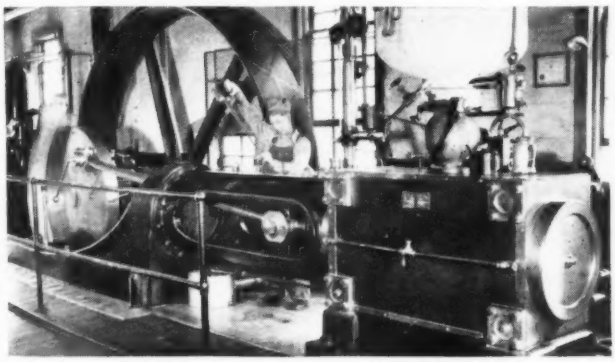
3. Even with these regulations to bring about equitable distribution of coal, all consumers must recognize that the fuel situation is nothing to cheer about, and will remain critical until some way is found to increase production. Therefore, it will be necessary for all consumers to do their utmost to conserve what coal they can obtain.

(*Continued on page 158*)



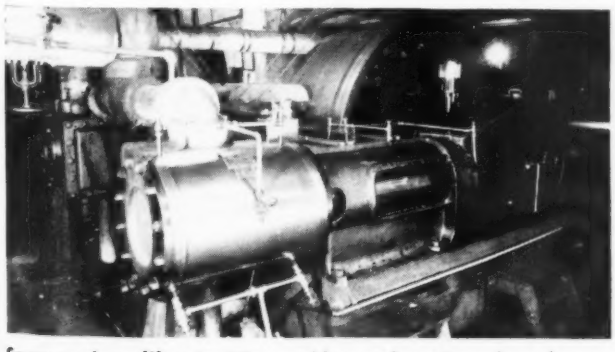
Steam engine indication is one method used by Standard Oil Engineers to bring back engine power.

During twelve years of normal operation a Corliss engine in a clay products plant gradually lost its pep—steam consumption also became excessive. The owner reports: "The engine was indicated and checked by your engineers, who recommended that several adjustments be made. We followed these suggestions and the engine is now operating like a new unit. Such engineering and technical advice has been worth real money to us. We appreciate the fact that your cooperative engineering service made this improvement possible."



Sluggish operation under load variations troubled the operator of a Corliss engine in a large Minnesota grain elevator. The engine operated cleaning equipment and conveyors, and was subjected to heavy loads as the grain traveled through the elevator.

A Lubrication Engineer analyzed the problem—poor atomization of the oil, was his conclusion. With the oil he recommended, the engine responds quickly to load changes. Incidentally, rod packing life is doubled as a result of better atomization of the new oil.



Some engines like the 20-year-old one above have been kept at peak condition by regular consultation with a Standard Lubrication Engineer. Periodic indicator service and continuous use of cylinder and engine oils recommended by the Engineer have kept repairs low and power output high. No rings were replaced in the 20 years, and no cylinder reboring has been needed at this paper mill plant.

Making yesterday's steam plants meet *today's demands*

MANY STEAM ENGINES old enough to have served in the last World War are again carrying a large share of the power load in this one. In the years between, few of these engines, or those installed later, have been called upon to produce nearly their rated loads. Maintenance and lubricating practices have been geared to an easy-going peacetime schedule. Today's needs have changed the pace. Equipment now must give unfailing service at full capacity.

Standard Lubrication Engineers have already helped many plant men bring power production up to wartime needs. A few examples are cited here.

The solutions may seem simple in telling. But years of lubrication experience are behind every recommendation—years of study and research in refining and compounding to produce cylinder oil to meet specific plant needs—years of work by these Engineers on power plant lubricating problems.

See if one of them can help you. Call any Standard Oil Company (Indiana) office or write 910 S. Michigan Ave., Chicago 5, Ill., for the Engineer nearest you. In Nebraska, call any Standard Oil Company of Nebraska office.

Oil is Ammunition . . . Use it Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

BRICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION E

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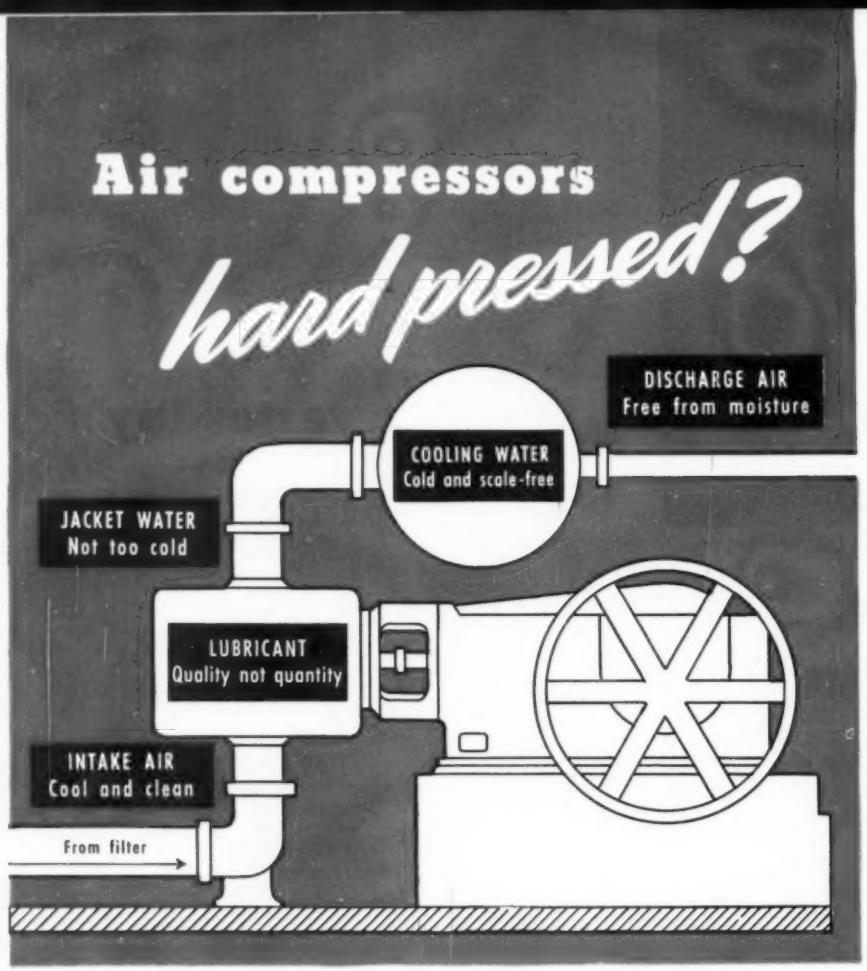


Here are some suggestions to help keep them out of trouble

CONDITIONS under which compressors operate, particularly under today's heavy loads, tend to cause excessive deposits. Improper lubrication is not always responsible for these deposits, but a compressor lubricant with the right qualities can reduce or eliminate many of them. The causes of some of the more common compressor operating problems and suggested cures are listed here:

Unstable Oils. Oxygen in the air and heat generated by compression tend to oxidize conventional oils, causing the formation of carbon and asphaltic substances which deposit on valves.

Keep intake air temperatures as low as possible. Be sure inter-coolers and after-coolers are supplied with an ample flow of cold water to keep air temperatures as low as possible. Keep this equipment clean and free from scale and rust. Use Stanoil from which the unstable hydrocarbons—those affected by heat and oxygen—have been removed, eliminating many troublesome deposits at the source.

Dirty Intake Air. The enormous volume of air required by compressors, particularly under heavy load, may introduce a large quantity of dirt and dust.

Be sure conditions have not changed which might increase such contaminants in the intake air in your compressors. Use efficient air screens and keep them clean. Use Stanoil which resists the formation of gummy deposits that might collect dirt and dust from the air and add to deposits on valves.

Condensation in Cylinder. Cooling water temperatures are extremely important. If water supplied to the cooling jacket is excessively cold, it will cause moisture in the compressed air to condense. This will wash off the lubricant film and cause excessive cylinder wear.

Preheat jacket cooling water by running it through the inter-cooler, or reduce the flow so that the temperature of the water when it leaves the water jacket is not below 100° F.

Condensation in Inter-coolers. Water in the inter-cooler should be cold enough to condense the oil and moisture in the compressed air, so that they can be removed before they enter the high pressure cylinder and cause excessive deposits.

Be sure an ample flow of cold water is supplied to the inter-cooler. Drain condensed oil and moisture from inter-coolers and after-coolers frequently if they are not provided with automatic outlets.

Over-Lubrication. Over-lubrication is the cause of much compressor trouble. In compressor operation, oil is not burned up as it is in internal combustion engines, nor is it washed away as it is in steam engines. Oil remains in the compressor cylinder a long time, and if it is of the right quality, very little is needed. An excessive amount of oil increases the possibility of deposits in valves, inter-coolers, and air lines.

Adjust oil feed to the minimum necessary to give an adequate film of lubricant on cylinder walls. Compressors usually require from one-fifth to one-tenth as much oil as steam cylinders of similar size. Because of the high lubricating quality of Stanoil, only a very small amount is needed to secure adequate lubrication.

Oil is Ammunition . . . Use it Wisely

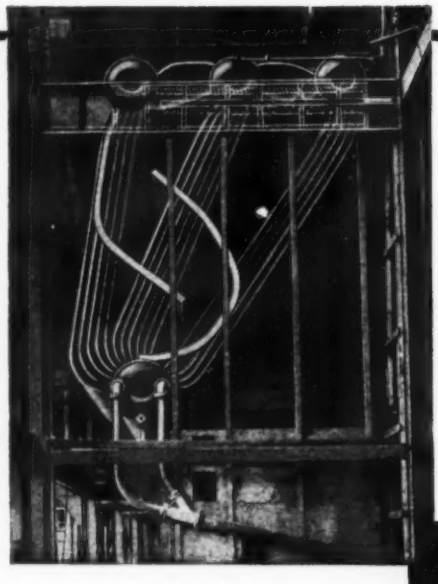
STANOIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

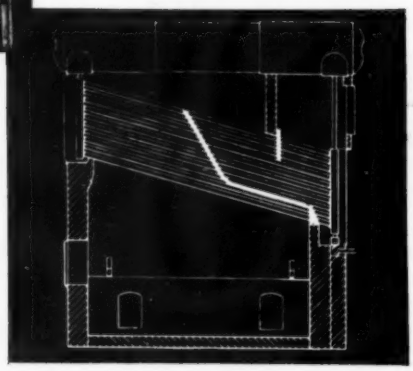
AIR IS LIFE TO A DEEP-SEA DIVER
BUT DEATH TO UNSTABLE TURBINE OILS!
Merely because your turbines are running "smooth as silk" today is no reason for assuming that they can't give you trouble in the near future. For when those devilish, little air bubbles get working on an unstable oil, trouble starts.
To make certain the oil you now use is doing the job it should, compare its performance with the performance records of Shell Turbo Oil which we will be glad to furnish you on request. You'll find the *oxidation stability* of Shell Turbo Oil far beyond what was ever thought to be possible in turbine operation a few years ago. And when you couple this with the ability of Shell Turbo Oil *to prevent rust,* you have a turbine oil that's worthwhile investigating.
You can't afford to wait until trouble starts . . . call in the Shell man now. Or write Shell Oil Company, Inc., Dept. "H," 50 W. 50th Street, New York 20, N. Y. or 100 Bush Street, San Francisco 6, Cal.
SHELL
SHELL TURBO OIL
Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil

MORE STEAM

QUICKLY EASILY



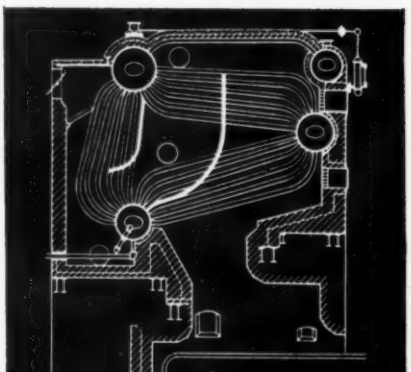
Steam output can be boosted quickly and easily by installing Enco baffles. These streamlined baffles prevent eddy currents and dead gas pockets. The cross-flow puts every square foot of heating surface to work.



Enco baffles reduce draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are more effective and used less often.

Each application is individually designed on the basis of 25 years experience with Enco baffling in all types of water-tube boilers.

Installations are made by skilled mechanics with selected materials.



FREE BOILER BAFFLES

● *A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.*

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

"It is patent that the larger users of coal probably will be able to effect the least savings," the Administrator says. "For example, the railroads and the electric utilities and numerous other big consumers have long carried out well organized conservation programs which have resulted in many instances in reducing their coal requirement close to an absolute minimum.

"It is therefore quite clear that the largest savings must be made among industrial consumers by those firms who have paid the least attention to conservation. Such consumers must make positive efforts to save coal. They cannot help themselves or their country by adopting the attitude that, 'It is my coal. I'll use it the way I want to.'

"I have been informed by highly skilled and well informed engineers that many really large consumers have never made any special effort to conserve coal. I am sure they will when they realize that it simply must be done if we are to carry on our war activities.

"I am sure that most of these consumers who can save coal, if they will make a positive effort to do so, know how to save coal. If there are any who would welcome advice or assistance there is an easy way to get help. Right now the Solid Fuels Administration is organizing the National Fuel Emergency Council which eventually will make available skilled engineers for inspections and advice on fuel conservation questions in many of the key cities of the United States."

AISE Meeting

(*Continued from page* 105)

consider that roughly for every dollar's worth of electrical apparatus, three-eighths of a man-hour has been expended.

But do not overlook the indirect saving in manpower. For instance, if you save power it may not at first glance appear as a man-hour saving, but it takes manpower to produce power. In addition, this saving may mean more power in other locations, which will allow an increase in badly needed production. In all probability for every dollar's worth of steel turned out, you expend in the neighborhood of three-eighths of a man-hour. If you save a dollar in your operations, therefore, you have saved approximately three-eighths of a man-hour.

Mr Mohler cited several examples of using robots, such as the amplidyne,

OURS is giving him better WIRE ROPE!

IT'S NOT ALWAYS easy to see the tie-up between positioning a crane load with finger-span accuracy – and blasting the enemy. But, look at the fronts where industry is fighting and there's nothing remote about it. Yours is a front line job . . . as necessary to winning the war as it is for securing the peace.

And our job of keeping you supplied with a tough, easy-to-handle wire rope like "Blue Center" is no less vital. First choice with outstanding plants throughout the country, you'll find it resists the loads and shocks of all types of rope-rigged equipment . . . withstands the crushing and abrasion of high speed operation . . . gets full capacity from men and equipment through easier handling, fewer shutdowns, more sustained production.

☆ ☆ ☆

Yes, Roebling "Blue Center" Steel Wire Rope is conserving steel for all America . . . by staying on the job longer . . . by meeting emergency service conditions unfailingly, wherever wire rope has a job to do, for Victory.

ROEBLING

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STEEL WIRE ROPE

PREFORMED OR NON-PREFORMED

GIVE *YOUR* WIRE ROPES A *FIGHTING CHANCE!*

and they will deliver the full length of service that has been built into them. To help you, Roebling has assembled a wealth of conservation data and boiled it down on a 4x5 inch tag that can be fastened right to the equipment. Printed in two colors and varnished to stay clean, it's a convenient way to remind and instruct operating men about such vital precautions as: Proper Installation, Correct Spooling, Proper Use of Clips, Regular Lubrication, Frequent Inspection and Careful Operation. Copies are yours for the asking. Write our nearest office and specify Tag "A".

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Simplifies pipe line maintenance

This one Babbitt Sealant will handle 90% of the power field's sealing jobs—as a lubricant-sealer for threaded pipe joints (particularly those subject to vibration, heat or solvent action), as a casing joint seal, a gasket dressing, and in many other applications.

Like all Babbitt Plastic Sealants, Sofset No. 74 assures leak-proof, permanently workable unions that can be taken down easily at any time without damage—an important factor in simplifying pipe line maintenance, saving time, labor, material and money.

Write for Bulletin PB-1, describing Babbitt Sealants and their applications

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selsyns, portable rectifiers, electronic tubes, electro-pneumatic contactors, meters and instruments and other devices, to save manpower, increase production and improve its quality in operating electric hoists and shovels, coal washers, practically all steel manufacturing power generation and distribution, and many other applications.

Electric power-system protection: L L Fountain, Westinghouse Co, called attention to steel-mill power loads that have increased until some require a power supply suitable for a medium-sized city. Such power concentration presents problems that are usually only in the category of utility centralization systems. Most steel mills generate sizable power blocks in their own plants, besides frequently tying in with a local utility, either for supplementary or standby service.

Distribution of this power to the various points in the mill requires and gets serious consideration from the standpoint of economy and continuity of service. The latter is always forcing itself into the limelight since no certain means of preventing faults on power systems is available. Power-generating and transmitting equipment have improved to where few faults are due to their failure. They occur, nevertheless, and must be coped with.

Relay Applications

Modern relays, properly applied to a well-designed distribution system, go a long way toward minimizing effects of faults on power-supply continuity. Proper application and choice of correct relay for the type of line follow no set rule, said Mr Fountain, and each case requires careful analysis. The following usually has to be taken into consideration: minimum fault currents, maximum fault currents, when the system is grounded both maximum and minimum phase and ground currents, phase and ground voltages, phase angle between current and voltages under fault conditions. After outlining the problems, Mr Fountain discussed each type of distribution system and indicated the relay to protect the system and told how each relay functions under different fault conditions.

Ac-crane load control: Although many methods have been applied in the design of ac hoist controllers they are not generally acceptable because each method is limited to a few applications. These methods include manual or automatically controlled loading brakes, regenerative braking, single phasing, dc braking, and counter-torque lowering. Speed-torque characteristics of the conventional secondary-

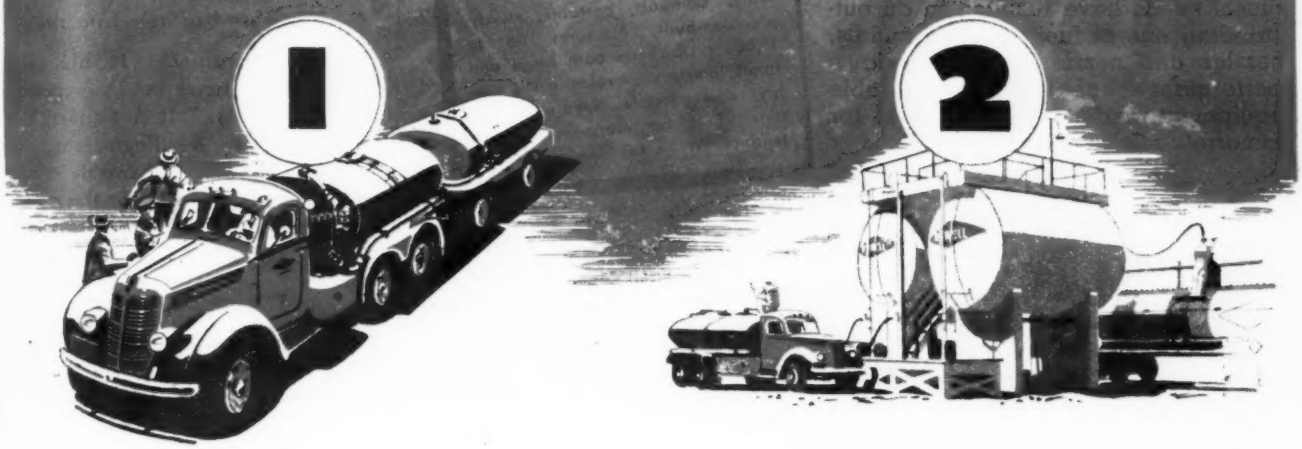
TWO BIG REASONS

WHY INDUSTRY INDORSES

DOWELL

INDUSTRIAL SCALE REMOVAL SERVICE

. . . THE SERVICE THAT SAVES TIME, MANPOWER AND EQUIPMENT



SPECIALLY ENGINEERED MOTORIZED EQUIPMENT

To provide Dowell Industrial Scale Removal Service to Industry—and eliminate the necessity of dismantling the equipment to be cleaned—Dowell operates a fleet of specially designed motorized units. This equipment—manned by competent, well-trained engineers—is equipped with special pumps, tanks and fittings for handling chemical solutions quickly and efficiently.

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Write Dowell's Tulsa office about your scale removal problems

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General Offices:
Kennedy Building, Tulsa 3, Oklahoma
Subsidiary of the Dow Chemical Company

FIELD STATIONS FOR FAST SERVICE

Dowell maintains field stations in many states where chemicals are stored and mobile equipment is serviced. Analytical devices are available at these stations for determining scale compositions and with this information the best type of scale removal solvent can be selected.

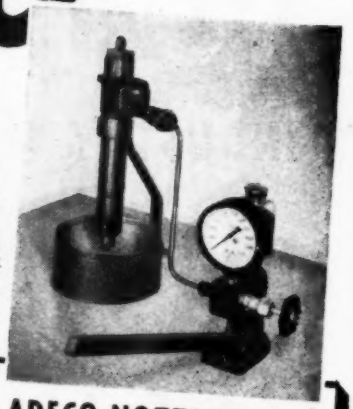
Look to

DOWELL

FOR INDUSTRIAL CLEANING AND SCALE REMOVAL SERVICE

ADECO

DEPENDABLE
DIESEL FUEL
INJECTION EQUIPMENT



ADECO NOZZLE TESTER
For Economical Maintenance

America's most widely used Nozzle Tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressures up to 10,000 p.s.i. Tests both large and small injectors. Avoids costly delays and possible damage to engine. Best for economical maintenance. Write for new bulletin.

Throughout the diesel industry, Adeco stands for the finest in fuel injection equipment. Years of experience in pioneering equipment for America's diesel needs have resulted in an outstanding line of fuel injection pumps, nozzles and nozzle holders. Today's performance of this dependable equipment merits your confidence for tomorrow's requirements.

AIRCRAFT & DIESEL EQUIPMENT CORPORATION
4401 North Ravenswood Avenue • • Chicago, Illinois

resistor controller for slipring motors in general have been satisfactory for hoisting. The difficult problem has been to provide a simple method which produces the desired characteristics for lowering the load. E J Posselt, Cutler-Hammer, Inc, described a new method of ac-crane-load control and showed how to obtain speed-torque characteristics satisfactory for general application with a standard slipring motor.

Unbalanced voltages, impressed across the primary of a wound-rotor motor with suitable secondary resistors provide the desired speed-torque curve for lowering operation. Since an unbalanced system may be considered as two balanced systems rotating in opposite directions, such a system may be compared to two motors having a common shaft and connected for rotation in opposite directions. Then by adjustable separate control a net shaft torque desired for driving or retarding a load is produced. Mr Posselt called attention to several methods of providing unbalanced voltage for the motor circuit, stressing an auto-transformer scheme.

Variable-Voltage Control

Motor applications: In his paper, "AC and DC Drives for Draw Benches and Wire Blocks." R A Geuder, Reliance Electric & Engineering Co, described seven ac and two dc combinations of electric drives for these applications and outlined advantages and disadvantages of each. These drives include ac squirrel-cage single-speed motors; ac squirrel-cage 2- 3- and 4-speed motors, non-accelerating; ac squirrel-cage motors, 2-speed accelerating; ac slipring motors; ac slipring motors with unbalanced secondary control; ac squirrel-cage motors with eddy-current clutches; ac squirrel-cage motors driving hydraulic units; dc motors with 2 to 1, 3 to 1 or 4 to 1 speed ranges; and dc motors with variable-voltage. After discussing the advantages and disadvantages of each drive, he reached the conclusion that from the standpoint of over-all flexibility, the dc motor with variable-voltage control offers the best solution.

Officers for 1944 are: president, C L McGranahan, assistant general superintendent, Jones & Laughlin Steel Corp; first vice-president, J L Miller, assistant chief combustion engineer, Republic Steel Corp; second vice-president, J S Murray, chief electrical engineer, Follansbee Steel Corp; treasurer, J D Jones, chief engineer, Youngstown Steel & Tube Co; secretary, Freeman H. Dyke, superintendent, blooming, bar and hotstrip mills, Wheeling Steel Corp, Steubenville, O.

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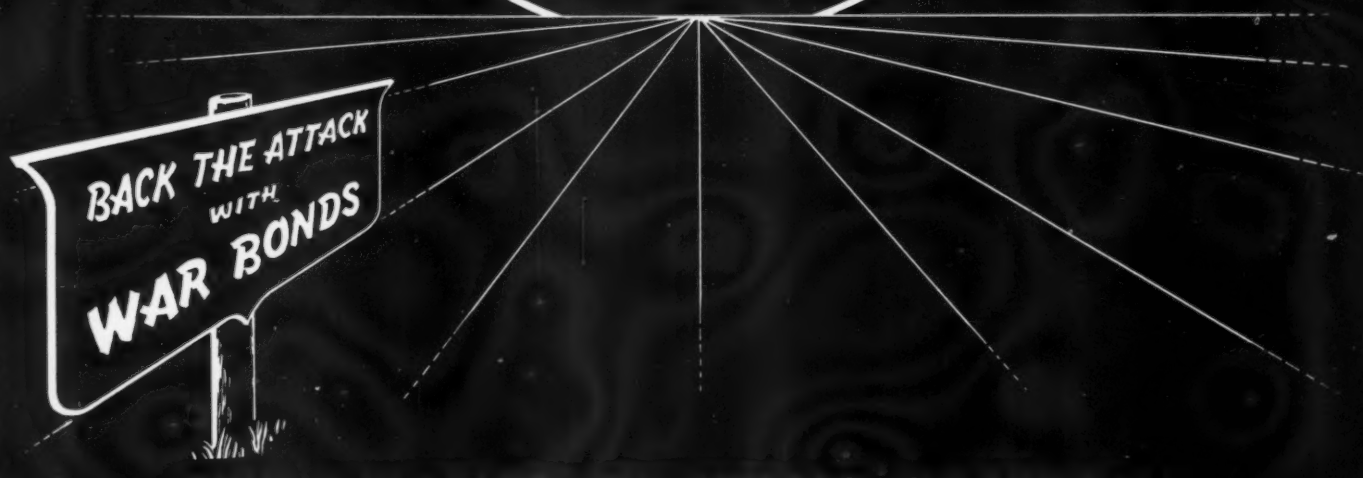

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Readers' Problems

(Continued from page 117)

noting pipe sizes and pressure variations. Friction losses can then be checked to see if pipe sizes are correct.

Needle valve in pressure line to the pilot valve diaphragm is adjustable to reduce pressure pulsations. Connection should be at least 10 ft downstream from the main reducing valve. Water for operating the main valve should come from a separate source or from the upstream side of the reducing valve, protected by a small reducing valve and strainer to insure clean water at a constant pressure. The supply pressure must be higher than the pressure required to operate the valve and be reasonably uniform in value. The needle valve in the operating line is set to control the speed of main valve movement and eliminate hunting.

Reducing valve operation should be checked when the flow is definitely known and preferably when it can be adjusted; measure pressures on each side of the valve.

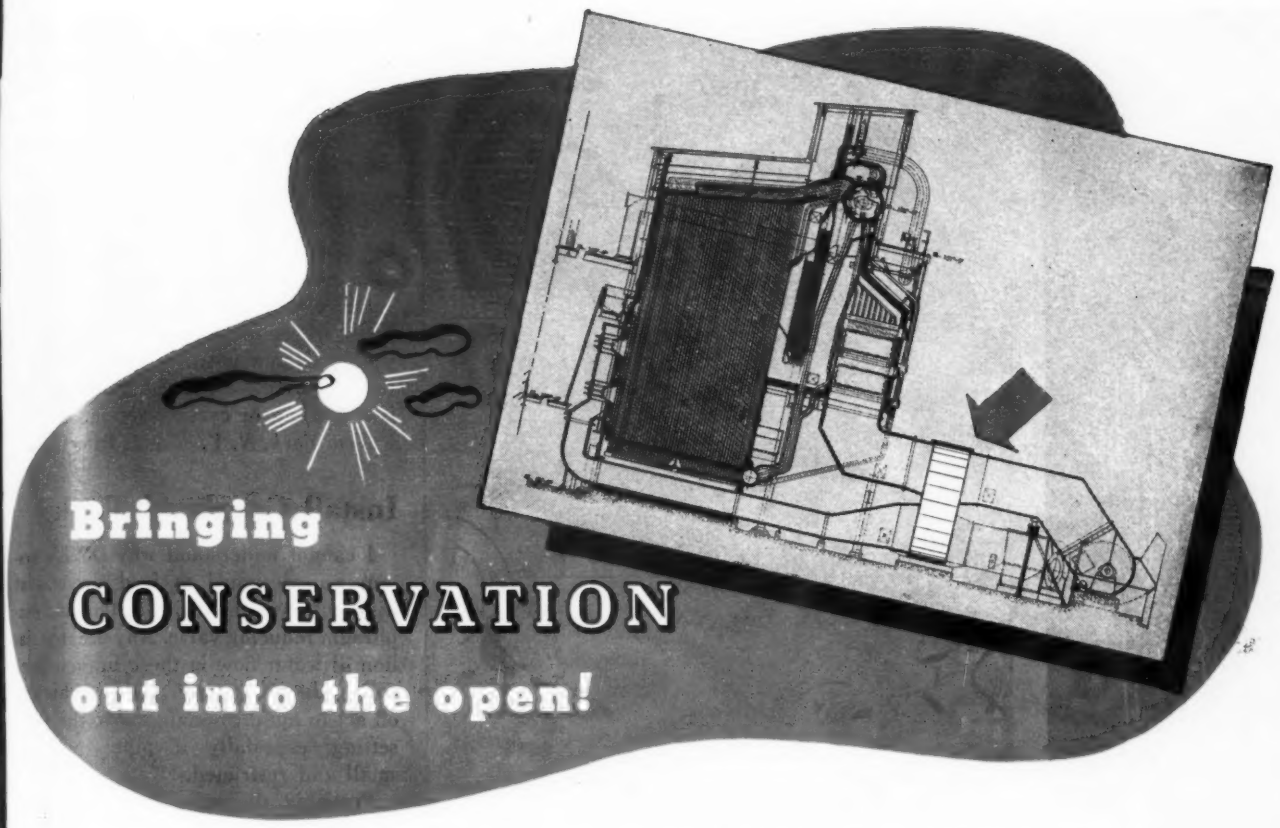
With adjustable flow rates, variations can be made until regulation is satisfactory. Since DWL has checked valve condition the trouble likely comes from incorrest installation, or undersized or choked branch piping. Determine internal condition of piping by measuring pressure at two points in line with known flow rate, then check the friction loss against tables for normal pipe at this flow rate.

Saint John, N. B. C G CLARK

Investigate Valve Friction

DWL's pressure-operated valves contain no energy in the diaphragms themselves, operation depending entirely on a balanced set of forces, equal and opposite in action, namely, the compression of a spring balanced by a diaphragm of a given area acted on by a unit of applied pressure. At the instant of operation the only energy available in the valve is the additional force applied by a change in pressure.

For example, if the diaphragm is 100 sq in. and the applied pressure 7 psi, then we have a total force acting downward of 700 lb. This force compresses the spring until equilibrium is reached by an equal and opposite spring reaction, and the valve is at rest. Now suppose that line pressure calls for a new valve position, which could be obtained by 7¼-psi total pressure? This



New Gulf Coast State Utility Plant of Outdoor Type Is Equipped with Ljungstrom Preheater

Here's a boiler plant in which fuel savings are backed up by sound conservation of steel and other structural materials. Designed for natural gas firing, it has a maximum continuous rating of 425,000 lb steam per hr. Operating pressure is 900 lb per sq in. Gases enter the preheater at 775 deg F, leave at 370, and heat the combustion air to 632 degrees. Preheater and fan assembly are installed out in the open between the steam generator and stack.

* * * * *

Ljungstrom Air Preheaters save fuel two ways. First, they recover heat that would otherwise be lost up the stack, increasing efficiency of the plant by 6 to 10 percent. Second, they provide more effective combustion conditions, a factor of particular importance in burning lean fuels. In some cases, preheating of combustion air makes it possible to use fuels that would otherwise be unsatisfactory.

At the same time, this compact *regenerative* type of preheater saves appreciably on steel and construction materials. First, because optimum heat recovery is obtained with *one-half* to *one-third* the weight of steel in the preheater itself, as compared to other types. Second, because lower weight and compact design permits a simple supporting structure.

Today, the *conservation* features of the Ljungstrom are expanding its application from high-efficiency boiler plants to a wide range of industrial applications where gas-to-air heat transfer can save fuel and improve combustion. These applications include oil heaters, metallurgical furnaces, and the like.

For the complete story on the operating principle and construction features of the Ljungstrom Air Preheater, write for a copy of Bulletin S-1.

For **PRODUCTION ACHIEVEMENT . . .**

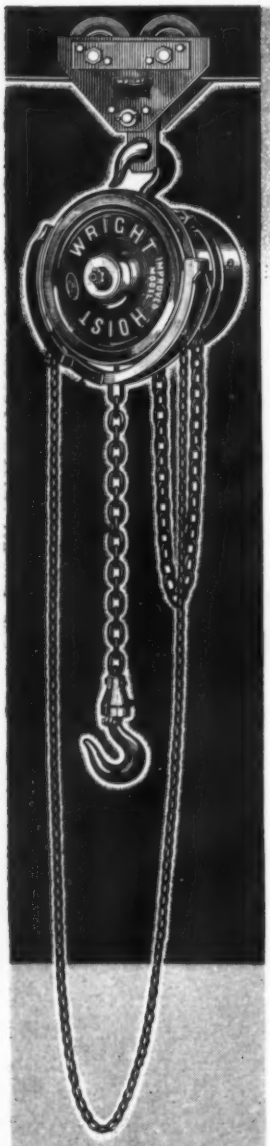
The U. S. Maritime Commission has awarded its "M" Pennant and Victory Fleet Flag to the men and women of Air Preheater Corporation.

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, New York



WRIGHT MAKES IT POSSIBLE TO TRUCK ON THE CEILING

No—it is *not* done with mirrors. It is done with either **WRIGHT** Improved High Speed Hoists, **WRIGHT** Speedway Electric Hoists, or **WRIGHT** Cranes.

WRIGHT material-handling equipment is tailor-made for *your* production problem. It doesn't matter whether your product is paper or locomotives, textiles or tanks, there is a **WRIGHT** hoist or crane that can handle it safely, rapidly, and economically.

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AMERICAN CHAIN & CABLE COMPANY, INC.

BRIDGEPORT, CONNECTICUT

In Business for Your Safety

WRIGHT
Improved
High Speed
HOISTS

extra ¼ psi gives an additional total force of 25 lb on the diaphragm.

The moving parts may have the equivalent of 25 lb applied force as friction in the stuffing box and valve superstructure. In such cases the valve fails to reach the position called for and the line pressure continues to change until the pilot raises the diaphragm pressure high enough so that the total applied force overcomes the frictional force. This, of course, causes the valve to jump to a new position which is beyond that required for control, and the result is a hunting or cycling action.

New York, N. Y. L C RINEHART

Install Overhead Tank

I cannot understand why DWL's system was designed to feed services at different elevations with a standard diaphragm reducing valve. Any great variation of water flow in these branch lines will reduce pressure and in shutting off act to build pressure above the valve setting, especially if pipe lines are small and restricted.

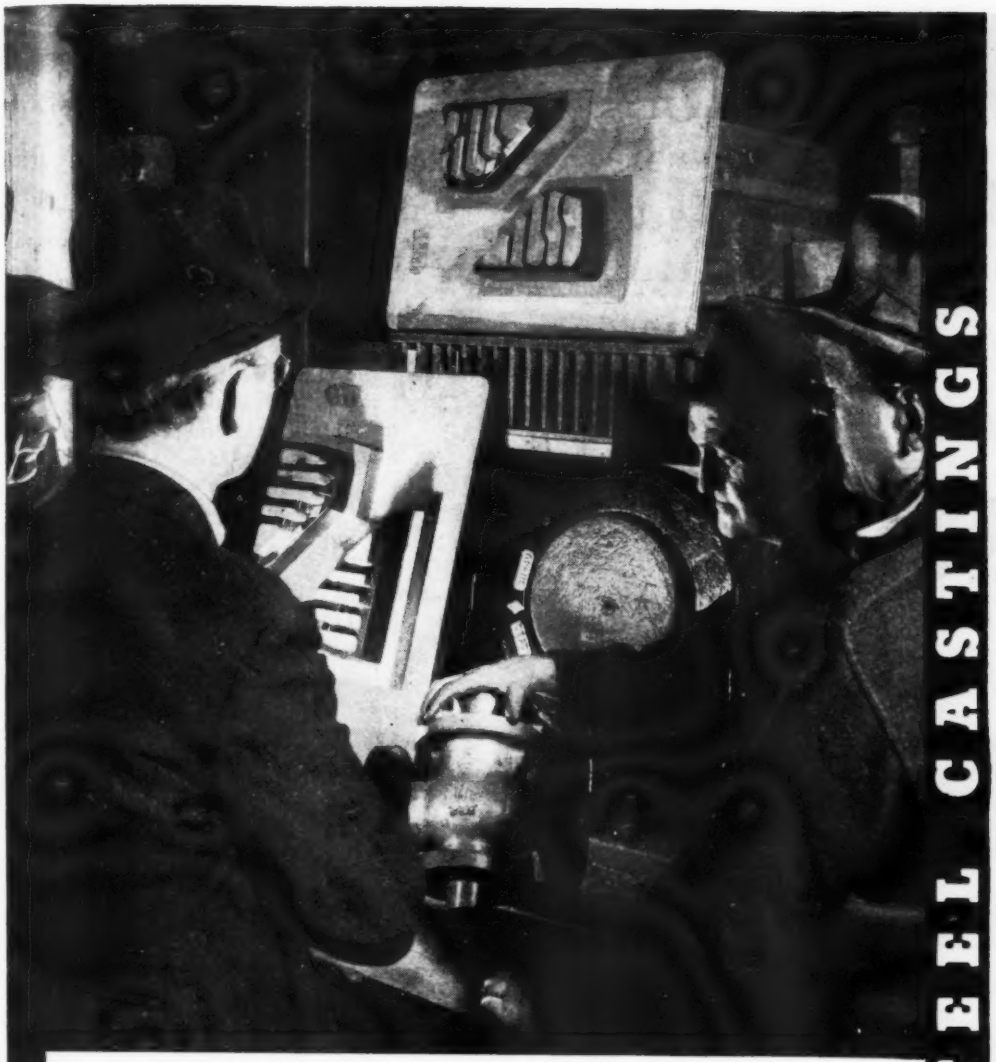
Probably the valve is not designed with the right size diaphragm or the valve seat area is too small, causing a great pressure drop at full flow. With main line pressure at 80 psi reducing to 40, diaphragm must be designed to operate valve under this reduced pressure and on deadend line the diaphragm is subjected to full pressure of 80 psi. Changing the spring tension either way will do no good if diaphragm size is not correct or if this valve was designed to reduce to a higher or lower reduced pressure. In this case springs would not be of the right strength and diaphragm would be too large or too small. Generally speaking the greater the pressure reduction the greater the diaphragm area required to operate the valve.

I suggest that DWL install a 500 or 1000 gal tank at top of building regulated by float valve to feed all services by gravity. This would avoid using reducing valves and would give a steady even pressure to all services. If city water failed services could still be maintained by gravity for a short time. The only objection to this would be that top floors of building would not have as much pressure as bottom floors. If pressure on bottom floors is too high valve can be throttled slightly.

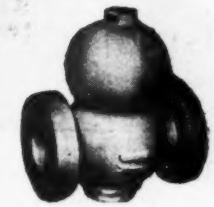
Ottawa, Ont. JOSEPH BONGIORNO

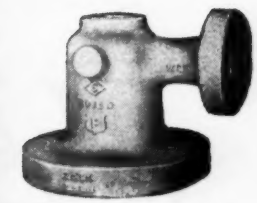
Lines May Be Clogged

If DWL inspects his lines and checks for corrosion or partially plugged pipes, he may find considerable sediment, and



SIVYER STEEL CASTINGS





PLANNING MAKES WORTH LOOKING FOR

Getting off to a good start is important when you're making steel castings good enough to wear the Sivyer trademark. Because quality is something that must be part of every phase of production, Sivyer plans that quality in each job before a pound of scrap is charged into a furnace. Here's a candid camera shot of a Sivyer Job Planning group. It includes the foundry superintendent, a metallurgist from our research laboratory, a pattern expert, the melter, and the foremen of the pouring, molding, heat-treating and finishing departments. Each studies the job, recommends proper procedure, and arranges the necessary supervision to make sure the job is handled right at every step. And it's being right at every step that is responsible for casting quality.

SIVYER STEEL CASTING COMPANY
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GAIN TIME
ship early in day !

Mr. Brown: When'll this order reach the consignee?

Expressman: Let's see. It's not ten yet. About five this afternoon. Same day delivery 800 miles away is easy, when you ship early by AIR EXPRESS.

OF course, AIR EXPRESS is by far the fastest form of delivery—direct by air or by rapid air-rail service between thousands of points in the United States and foreign countries. Yet precious time is often lost through the old pre-war habit of accumulating shipments for pick-up at the end of the day. So to *gain* time—to avoid heavy, peak-hour traffic that may delay your shipment—ship as early in the day as possible, so we'll be able to utilize the cargo capacity of all scheduled flights. This 3-mile-a-minute service is available direct to more than 350 U.S. cities and to scores of foreign countries.

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As a result of the great volume of Air Express traffic created by wartime demands and the increased efficiency developed to satisfy these demands ...Air Express rates within the United States have been substantially reduced, in some instances as much as 12½%, depending on the weight of the shipment and the distance it moves. Consequently, shippers nationwide are now saving an average of 10½% on air cargo costs.

NOTE TO SHIPPERS: *Ship Early*—as soon as shipment is ready—to assure fastest delivery. *Pack Compactly*—to conserve valuable space.

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it may be the cause of his trouble.

He should install a bypass line around the main valve because water supply can then be maintained if anything happens to this valve.

From his description the trouble must be in the pilot valve, so I would cut out the control and throttle the water flow by a hand-operated valve. In this way water flow at the drinking fountains can be checked. If the flow is steady it indicates that reducing and pilot valve are out of adjustment. If the flow is still erratic after adjustment, it indicates trouble somewhere in the lines. Perhaps line strainers are clogged with trash.

Philadelphia, Pa. T F CUNNINGHAM

Valves Too Small

Two things may cause DWL's trouble.

(1) As branch-line pressure surges from 40 to 80 psi, there is a possibility that the reducing valves are not large enough to supply volume of water necessary to maintain the set pressures.

(2) The same may be true of the main water-supply lines. If they are not large enough to supply the volume of water necessary instantly, initial pressure will drop causing a fluctuation throughout the system.

It is essential that the supply source be of sufficient volume, maintained at a constant pressure for satisfactory operation of the reducing valves.

Bogota, N. J. F O MEYER

Magnetic Reactive Power

(*Continued from page* 122)

currents can be resolved into their components as indicated in the answers in POWER's May issue. But because the active component of the motor current is opposite that of the generator current, subtract this motor component from the generator active-component total before finding the overall station pf from the equation $\frac{\text{net station kw}}{\text{total station kva}}$. Determine the magnitude and phase angle of I total by that of I_1 and I_2.

The motoring generator with overexcited field, then, does not improve the station pf. If the motor is near the system load center, it improves the system pf by relieving transmission lines, transformers and distant generators of part of their reactive load.

The usual reason for motoring the generator is that voltage is raised at the load, whether or not the system pf is improved.

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Each McAlear Control is a precision instrument—expertly engineered for ONE JOB and ONE SET of working conditions.

INFINITE CARE is exercised in its production. Machining operations are held to critical tolerances for leak proof surfaces and trouble-free mechanisms.

There are 500 McAlear Controls for regulating pressure, temperature and fluid transport. Every one constitutes effective insurance against control failure resulting in plant-paralyzing downtime.

When unusual working conditions require a special control for steam, water, air, chemicals, oil or gas, McAlear will develop it for you.

IF YOU HAVE A CONTROL PROBLEM... call on McAlear engineers. Draw on their fund of experience, on their ability and readiness to help you, whether for wartime application or post war planning. For informative bulletins and catalog, write McAlear Manufacturing Company, 1913 S. Western Ave., Chicago 8, Illinois.

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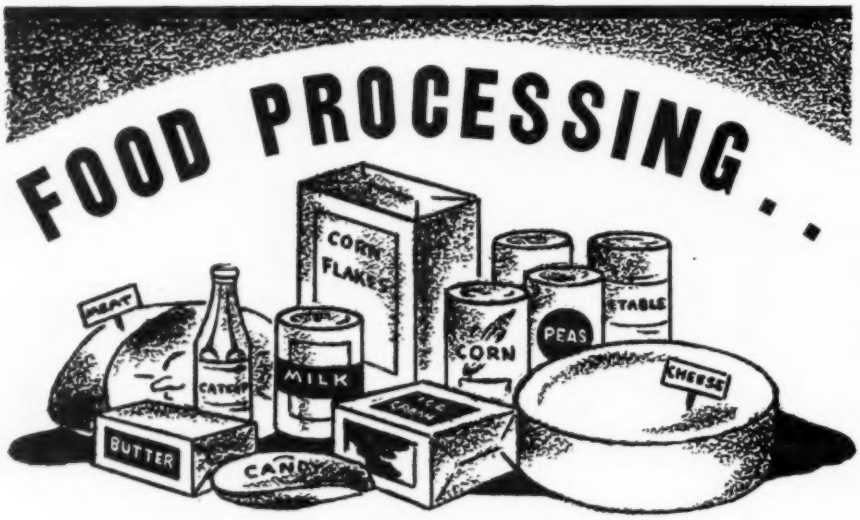

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In spite of being hampered by manpower, equipment and supply shortages, the food processing industry is nevertheless coming through with more food than has ever been processed in the history of our nation.

While many new plants mushroomed and much new equipment was installed, the bulk of this record-breaking production was accomplished by demanding more work from equipment that had been installed before "Pearl Harbor".

HENSZEY FEED WATER METERS for example have been in use for many years in practically every type of food processing plant in the country. They were chosen at the time for their rugged construction—their accuracy and for simplicity of installation.

When the demands of war required a new high in output, the Henszey Meters did their part along with the other equipment to help bring about this miracle of production.

If you have a liquid measuring problem in your war work, consider Henszey Meters. They accurately measure boiler feed water, boiler blow-down, condensate, free running chemicals and other hard-to-measure liquids. They are equally accurate at high or low flow—high or low pressures — on reciprocating or centrifugal pumps. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature. The entire meter is easily installed right in the line.

Write today for full information—stating the details of your problem will save time.

Sizes from 10 g.p.m. to 1200 g.p.m. cold water steady flow rating. Pipe connection ¾" to 6"—special sizes to order.

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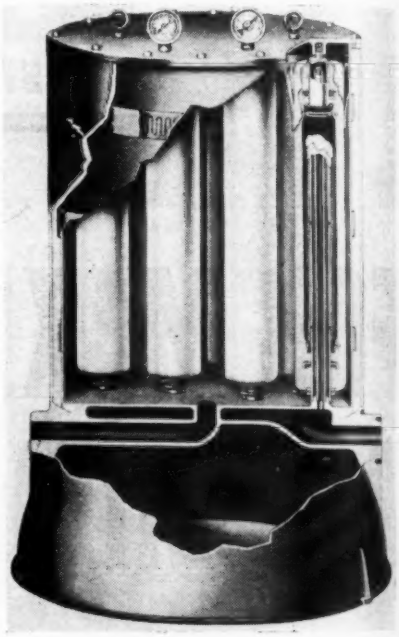
FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves

New Equipment

(*Continued from page* 130)

frame, is controlled by a single hand wheel. Maker states that tandem assemblies made up of two, three or more rheostats range in power rating from 25 to 1000 watts, and in diameter from $1\frac{9}{16}$ in. to 12 in. Rheostats in tandem are insulated from each other so that they may be used for simultaneous control of several circuits or phases of a circuit by means of one knob. Also available in taper windings with same range of resistance values as individual units. *Ohmite Mfg Co, 4819 Flournoy St, Chicago, 44, Ill.*



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PURIFIER designed to handle refined or crude diesel fuels at high rate of flow. Unit can be directly connected to purify fuel just before it enters the engine, or used in any kind of bulk station installation. Designed on a flexible arrangement that provides for grouping single elements in combinations of 1-3-5-8-12. Refills for all units are exactly alike. Operation of purifier, with exception of refill change, is entirely automatic. *Honan-Crane Corp, 204 Indianapolis Ave, Lebanon, Ind.*

Duct Assembly

AIR DUCT made from asbestos cement board or other non-metallic boards in thicknesses of ⅛, $\frac{3}{16}$ and ¼ in. are set in prefabricated steel corners and identified as Sheetlock. Closure is effected with steel strapping which is tensioned and sealed. Duct sections sometimes

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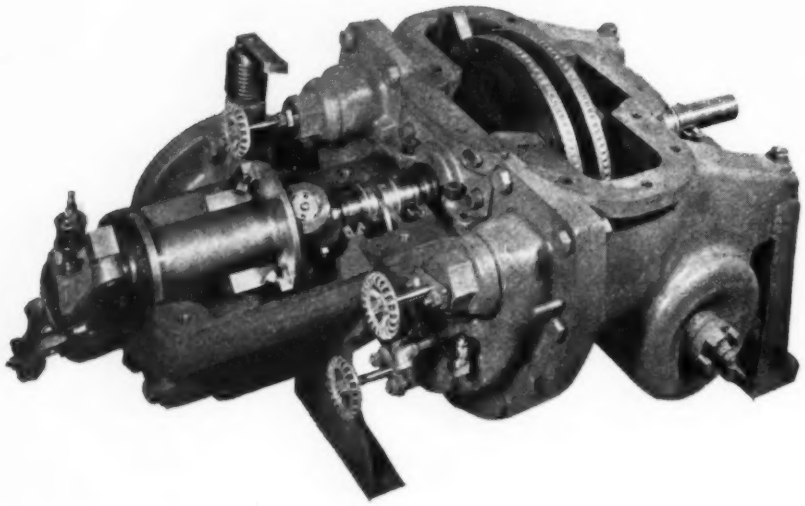
Casing split horizontally well above shaft center line



This unique and patented construction provides THREE highly desirable features in . . . . .

MURRAY TYPE "U"
Mechanical Drive Turbines

1 Longer steam ring allowing considerably more nozzle area and larger steam inlet size, thereby increasing the maximum horsepower developed by a particular frame.

2 Larger exhaust opening which permits of greater horsepower and improved efficiency, particularly for condensing operation.

3 Additional hand valves for nozzle control. (Note that view shows three hand valves on our smallest frame, whereas the usual small conventional turbine has room for only one.)

★ Other desirable features shown are the stainless steel blading and shroud, center line exhaust end support, flexible steam end support, balanced governor assembly, precision bronze backed babbitt lined bearings, effective bronze labyrinth type oil seals which supplant the older felt type and separate removable upper carbon packing gland cases.

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

joined together with 3-in. strips of asbestos material cemented over joints. Users obtain a more rigid and serviceable duct, maker claims. Steel strapping, tools: *Acme Steel Co, 2840 Archer Ave, Chicago, Ill.* Prefabricated corners: *Sheetlock Co, 4521 N Clark St, Chicago, Ill.*

Radiant Heater & Resistor

DESIGNED FOR high-temperature radiant heat, Regan radiant heater also serves as a resistor. Element consists of helical coil of nickel-chromium wire wound spirally around refractory core. Company claims that core does not deteriorate at temperatures up to 1700 F. Binding posts and straps are of Monel metal or nickel chrome, depending on user's specifications. Obtainable in 32- to 220-v range. *Techtmann Industries, Inc, 828 N Broadway, Milwaukee, Wis.*

Flexible Fastener

PACKLESS FLEXIBLE FASTENER, having combined functions of a supporting strap and a vibration absorber for stationary or movable tubing, has been added to line of vibration absorbers. Consists of a sensitive spring, cone-spiraled and terminating in a clip that

snaps on to the tube or similar unit to be fastened—the right size fastener being chosen to fit the OD of the unit. Fastener is attached to a supporting surface by means of machine or wood screw fitted through the cone. Device can be installed in either horizontal or vertical position. *Packless Metal Products Corp, New Rochelle, N. Y.*

Compressor Calculator

CALCULATOR is of slide-rule design for estimating volumetric efficiency, brake horsepower and total piston displacement of any make of compressor. Made of heavy stock measuring 3½ x 8½ in.

Twenty Three Years OF SUCCESSFUL STOKER BUILDING

Simplicity of Design—Long Life—Unequalled Economy—

Here is pictured a Chicago Automatic Stoker for a 300 h. p. boiler ready to be shipped from our shops after 72 hours of continuous running. This stoker is a duplicate of the one installed at the Peter Hand Brewing Co., Chicago three years ago. An 8-hour test run by an outside responsible company showed an evaporation of 10.2 lbs. of water and an efficiency of 83% with a cost of 14 cents per 1000 lbs. steam.

CHICAGO AUTOMATIC STROKER CO.
14 N. CLINTON ST. CHICAGO, ILL.

Peter Hand Brewery Company Chicago
1612-1632 Sheffield Ave.
Meister Brau
Peter Hand's Extra Pale Beer

September 15, 1943

Chicago Automatic Stoker Co.,
14 N. Clinton St.,
Chicago, Illinois

Gentlemen:

It has now been over three years since we installed our first Chicago Automatic stoker. We thought you would be interested in having the following information.

Our business has increased so much since we installed our first stoker that in 1940 we purchased a new 500 H.P. boiler and put in two of your #26 stokers. On the 300 H.P. boiler when we start our cookers, the load goes from 250 H.P. to 1200 H.P. in thirty seconds with only a loss of a few pounds of steam. We are still able to carry our load on the 300 H.P. boiler due to the stokers ability to take the great fluctuation in load without losing the steam pressure when we have to shut down the large boiler for cleaning. We are operating with a clear stack and no fly ash emission from the stack. As you know, at times we are compelled to burn a considerable amount of hops with the coal.

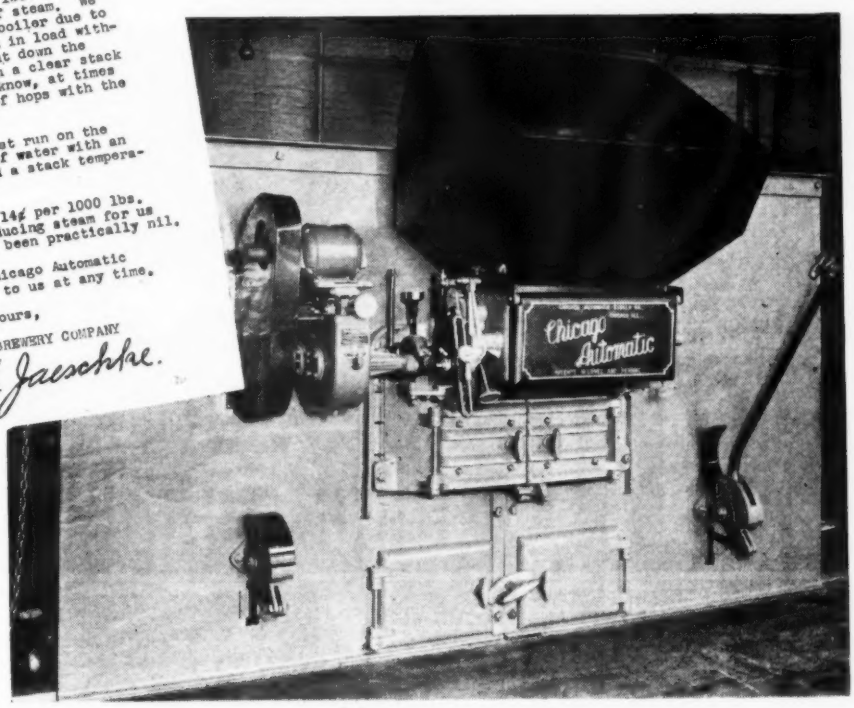
On April 26, 1940 we had an eight hour test run on the 300 H.P. boiler and we evaporated 10.2 pounds of water with an efficiency of 83.6, with a CO2 of 12 to 14% and a stack temperature of 450°.

Our cost of steam is a little less than 14¢ per 1000 lbs. The stokers are still operating and still producing steam for us at this low cost and our maintenance cost has been practically nil.

We are very happy that we put in the Chicago Automatic Stokers and pleased to have you refer anyone to us at any time.

Very truly yours,
PETER HAND BREWERY COMPANY
C. H. Jaeschke.

★ ★ ★



Chicago Automatic STOKERS

One-Man Operation Helps Solve Man-power Problem In Power Plants

Every Roto Tube Cleaner you put to work in your plant enables you to release one man for other productive work. A simple air valve on the Roto motor permits one man to operate the cleaner entirely by himself. This not only saves a helper, but eliminates delays caused by having to signal the helper to turn air off and on between every tube cleaned. The powerful Roto motor and keen cutter heads make short work of hard scale or soft, gummy deposits. Roto offers a wide variety of air- and water-driven cleaners for any cleanable tube from 1/2" to 12" I.D. Leading power plants enjoy the time- and labor-saving features of Roto Tube Cleaners. How about yours? Write today.

Roto Model 130 air-driven motor with swing-frame head and air valve for one-man operation in 3¼" curved tubes.

WRITE FOR DETAILS

The ROTO Company

145 Sussex Ave., Newark, N. J.

ROTO Tube Cleaners

FOR POWER AND PROCESS STEAM

HI-TEST

KEWANEE

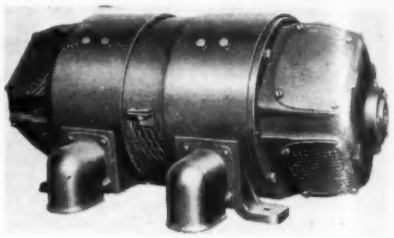
Quick steaming, all-welded portable with refractory lined firebox and 2-pass tubes to save fuel. 50 to 150 hp. 125 and 150 lbs. WP.

For 6" scale with pipe diameter markings, write Dept. 89K-XI

KEWANEE BOILER CORPORATION Kewanee, Illinois

Division of American Radiator and "Standard" Sanitary Corporation

Device with instructions offered gratis to responsible engineering and operating executives. Write direct to Cooper-Bessemer on company letterhead, giving writer's title. *The Cooper-Bessemer Corp, Mount Vernon, Ohio.*



Motor-Alternator Sets

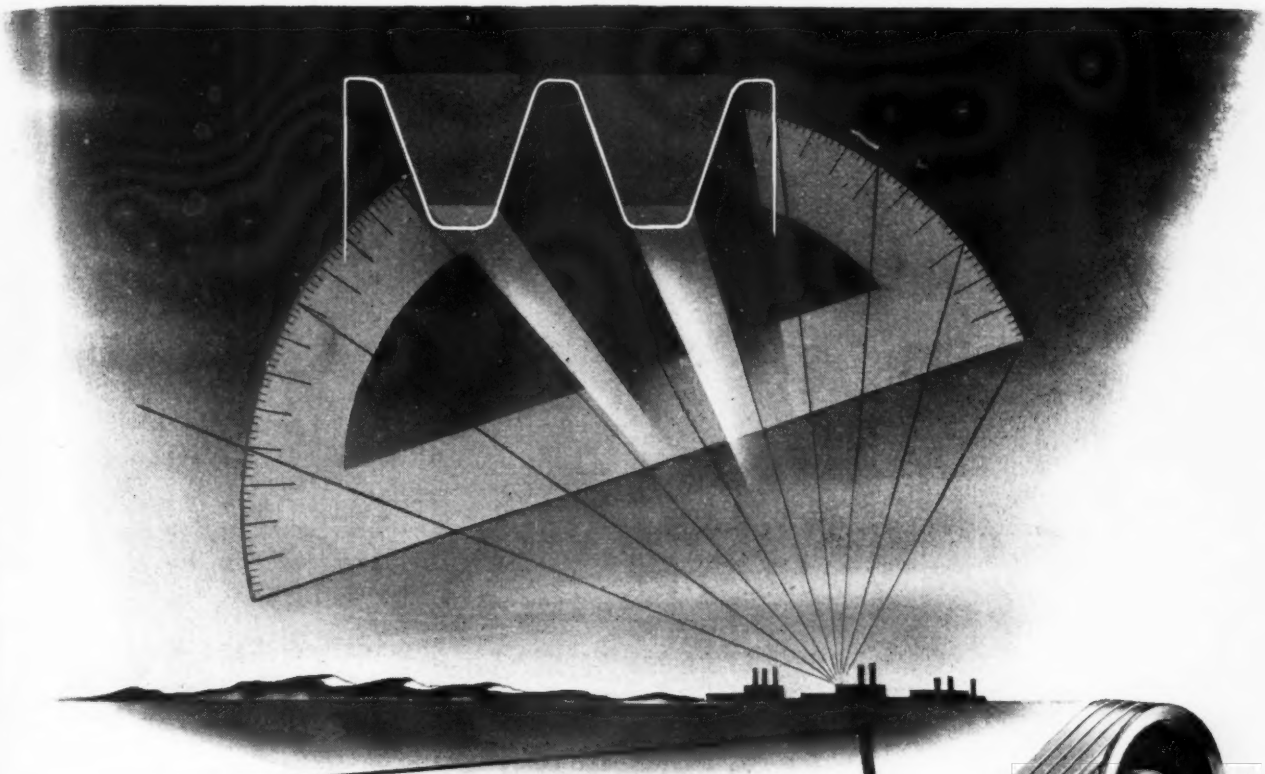
TWO-BEARING 3600-rpm motor-alternator sets in integral ratings up to 5 kva. single phase, designed for converting direct to alternating current for various applications requiring ac power. Motor and alternator are similar in that armature windings are on rotating elements and fields are stationary, attached to frames. Solid shaft, supported by a ball bearing at each end, serves to mount rotating members of both motor and alternator. Sets are easy to disassemble. Complete rotating unit may be pulled out of stator by merely removing an end shield. *General Electric Co, Schenectady, N. Y.*

Pipe Gage

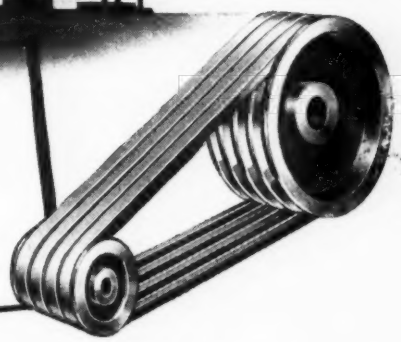
THREE-POINT PIPE GAGE measures all sizes of pipe from 1/8 to 12 in. Consists of two pivoted steel plates with edges curved at three points for contact with pipe to be measured, together with scale which registers pipe size in terms of inside diameter and drill size for tapping. Measures pipe in any position—also a covered pipe if there is a small opening near a union or other fitting where gage may be slipped in. It is also claimed that gage can be applied in dark places and taken to light for reading. Gage is 2½ x 4¼ in., constructed of steel with deep-etched numerals. *Three-Point Gage Co, 3821 Broadway, Chicago, Ill.*

Panel Instruments

AVAILABLE with either brass or molded Textolite dust-proof and moisture-resisting cases in 2½-in. sizes, line consists of dc voltmeters, ammeters, milliammeters, micro-ammeters, radio-frequency ammeters and milliammeters, and dc volt-ammeters. Pivots of instruments are mounted on inside of armature shell instead of being secured to outside of armature winding. One jewel bearing is mounted on top of core-and-frame assembly, the other in



The DOMINANT DRIVE is adaptable...



...and that's Important

In machine design and factory layout—the twin problems of convenient location and space limitations were a constant plague to the engineers of yesteryear. With the advent of the Multiple V-Belt Drive—and its adaptability to any angle or plane, and short center design, these sources of concern became nonexistent.

The Dominant Drive may be applied vertically, horizontally, or angularly at any degree, because the wedging action of the V-Belts in the sheave grooves provides a positive grip that pulls the load with minimum tension.

Simplicity itself—yet the most efficient angle of the belts and sheave grooves was established only after exhaustive co-operative research by the engineering staffs of Multiple V-Belt Drive Association members. And this was just one of many factors which had to be worked out by trial and error and painstaking experiment which culminated in the development of the Dominant Drive of Industry.

The use of this emblem by an association member in connection with Multiple V-Belt Drives is assurance of mechanical excellence...the result of co-operative engineering, research and experience.

MULTIPLE V-BELT DRIVE ASS'N

Trade Mark

MULTIPLE V-BELT DRIVE ASSOCIATION

140 SOUTH DEARBORN ST., CHICAGO

buell

DUST RECOVERY SYSTEMS

Recognized throughout industry for their outstanding qualities and performance

★★ High Efficiency mechanical flue dust collection to meet the specific requirements of any job

★★ Ready Adaptability to any existing duct work

★★ Low Initial Cost

★★ Low Maintenance and Operating Cost

★★ Power Consumption as low as 1 H.P. per 20,000 pounds of gas per hour.

BUELL ENGINEERING COMPANY, Inc.

10 CEDAR STREET, NEW YORK

WRITE FOR BULLETIN G-842

Buy War Bonds and Make the Axis Bite the Dust

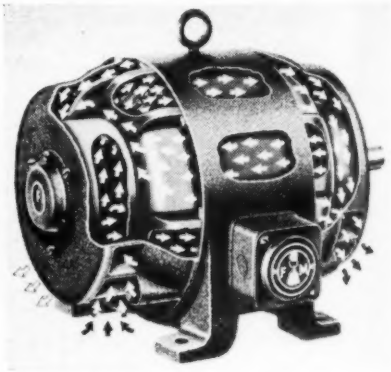
an adjustable sleeve fitted into lower part of soft-iron core. It is claimed that instruments operate satisfactorily in temperatures from —50 C to 70 C, and are accurate to within limits of ±2% of full-scale value. *General Electric Co, Schenectady, N. Y.*

Lamp Ballast

PERMA-GAP BALLAST offers the following advantages, according to the maker: (1) long fluorescent-lamp life, (2) sufficient starting current to preheat lamp cathodes, (3) operation of lamp at normal voltage and wattage, (4) regulation that is not destroyed by line-voltage fluctuations, (5) low wattage loss, (6) minimum operating temperatures, (7) low noise level. *Industrial Electronics Corp, 951 McCarter Highway, Newark, N. J.*

Squirrel Cage Motor

POLYPHASE SQUIRREL-CAGE induction motor constructed with centrifugally-cast F-M Copperspun rotor. According to company, motor is fully protected against falling particles and dripping liquids in any mounting position. Ball bearings sealed in cartridge housings. Cross-flow ventilation, through protected inlets, exhausts at each end of motor. Has no moving external parts. Frame



is cast in one piece with rib sections. Conduit box provides alternate assembly either recessed flush with frame or conventional external mounting. Motor rated 40 C and designed to carry 115% load continuously without injurious heating. *Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.*

Aluminum Deoxidizing

DEOX-ALUMINUM is an alkaline solution used as a dip, at room or elevated temperatures, from 10 sec to 1 min. According to manufacturer, it protects aluminum galvanically, acts as a paint base, prevents oxidation in transit, storage or hold-over operations, and under certain conditions acts as solder

THE COST OF LEAKS

SIZE OF OPENING	AIR 100 LBS. PRESSURE		STEAM 100 LBS. PRESSURE		WATER 40 LBS. PRESSURE	
	CU. FT. WASTED PER MONTH	COST AT 10c PER M.	LBS. WASTED PER MONTH	COST AT 60c PER M.	GAL. WASTED PER MONTH	COST AT 15½c PER M.
3/8	9,979,200	$997.92	460,000	$276.00	692,400	$108.00
1/4	4,449,600	444.96	203,000	121.80	307,700	48.00
1/8	1,114,560	111.46	50,500	30.30	76,900	12.00
1/16	278,640	27.86	12,750	7.65	19,200	3.00
1/32	69,552	6.96	3,175	1.91	4,800	0.80

Time to start figuring . . .

THE COST OF VALVE NEGLECT

It's not hard to figure! The factual chart above shows that a few leaky valves can be *extremely* expensive. And, when you consider the cost of a new valve against the cost of *reseating*, you arrive at a money-saving decision: to use Dexter Valve Reseating Equipment.

The saving of a few valves pays for the whole Dexter outfit. From then on it will continue to pay big dividends — by stopping the leaks shown above; by prolonging the life of many costly valves; by saving shut-downs and high labor expense.

Study this informative chart — then write us for complete data on Dexter Valve Reseating Equipment as applied to your valve problem.

A COMPLETE VALVE RESEATING OUTFIT IN A HANDY KIT-BOX —for Globe, Gate and Pump Valves

Use **DEXTER**

VALVE RESEATING EQUIPMENT

THE LEAVITT MACHINE COMPANY

ORANGE, MASSACHUSETTS

SOMETIMES IT PAYS TO LAY IT ON THICK!

Use B-H WEATHERSEAL to Protect Exposed Insulation

Cover all insulation exposed to infiltration of water or moisture with B-H Weatherseal. This Baldwin-Hill product is an emulsified, asphalt compound furnished ready-mixed in plastic form. By reason of its exceptionally high coverage and low percentage of shrinkage, the per square foot cost is low. One hundred pounds will cover 55 square feet of surface ¼ inch thick. After drying, dehydration reduces the thickness to ⅛ inch, giving a smooth, complete seal over the entire area. You simply trowel it on. Stays permanently black—no fading or spotting. Send for generous sample of B-H Weatherseal and see for yourself how easily and thoroughly it works.

BH **BALDWIN-HILL CO.**

575 KLAGG AVE. • TRENTON 2, N. J.

NEW YORK, N. Y. • CHICAGO, ILL. • HUNTINGTON, IND. • KALAMAZOO, MICH.

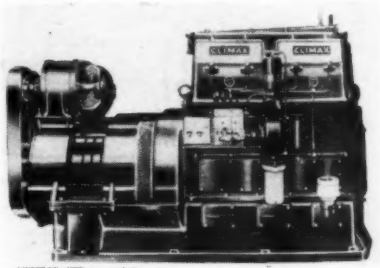
base. For use on all alloys of aluminum in the wrought cast or forged forms. Bath serves as an aluminum anodizing rack stripper and as a general cleaning method. *Colonial Alloys Co, Technical Processes Div, Philadelphia, Pa.*

Welding Positioners

OUTSTANDING FEATURE of recently developed P & H positioning machines is dual capacity rating of each model. Model WP-6 handles loads up to 6000 lb maximum and also has secondary capacity of 9000 lb maximum. Standard models made in dual capacities up to 24,000 lb. Construction is for constant heavy-duty service, employing all-welded rolled steel throughout, with strong box mounting. All models have portable or in-the-floor mounting for both ac and dc. *Harnischfeger Corp, Welder Div, Milwaukee, 14, Wis.*

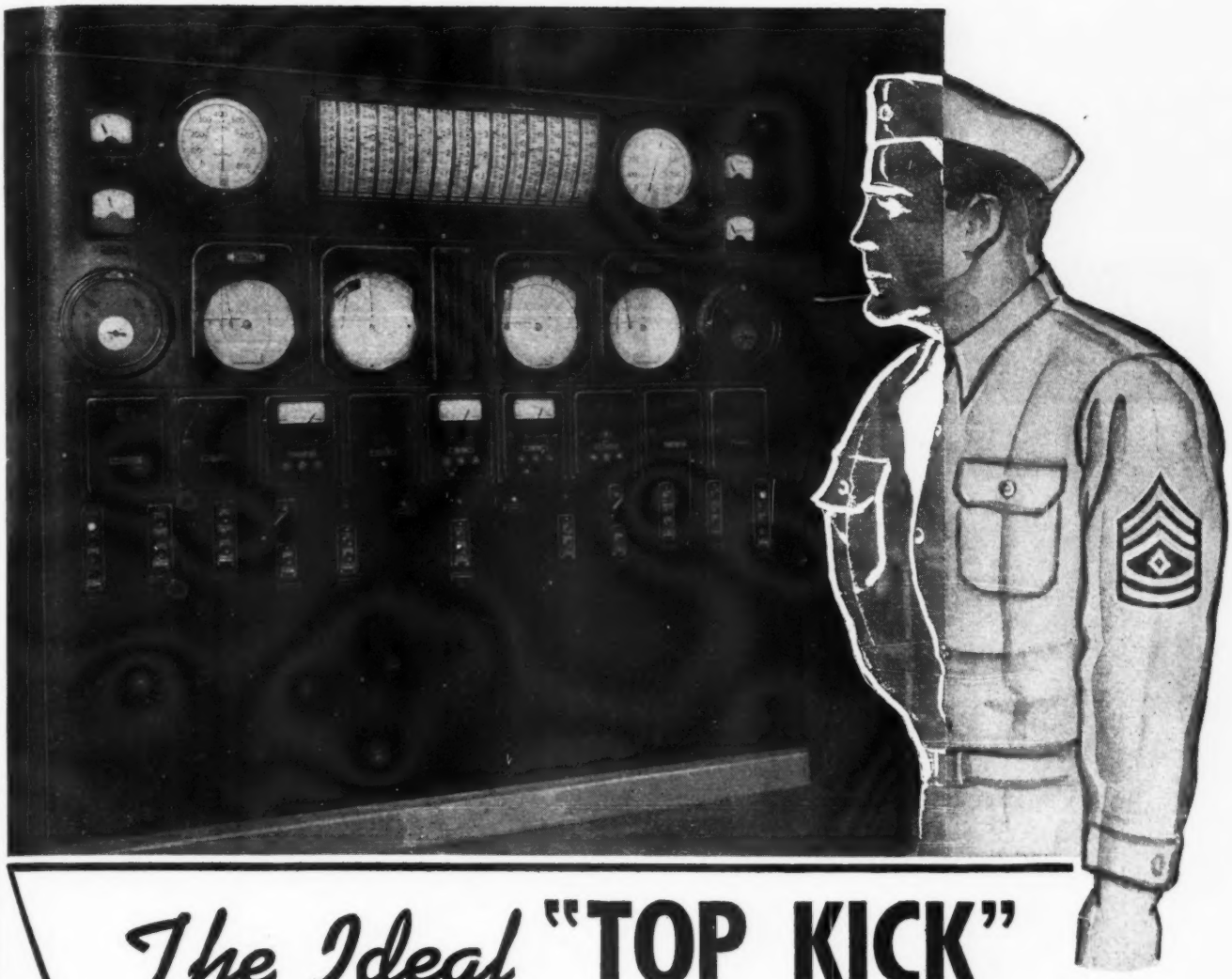
Photoelectric Colorimeter

LUMETRON COLORIMETER Model 400-H, designed as a portable self-contained instrument, is operated by a built-in battery, which requires no power connection. Particularly suited for field use and wherever electrical current is not readily available. According to maker, colorimeter is suitable for all tests which have heretofore been carried out with aid of color standards and visual comparators. Company claims it offers greater operating speed, higher accuracy, and elimination of human element. *Photovolt Corp, 95 Madison Ave, New York, 16, N. Y.*



Diesel Engines

MODELS D148 AND D297 are 4-cycle solid-injection engines for use as light plants and primary drives for pumps, compressors, mills, mine equipment, marine units, etc. Model D148, 2 cyl, with maximum rating of 22 hp, may be equipped for pulley drive with or without clutch, or clutch and reduction gear, or auxiliary power takeoff. As a diesel-electric plant, it is available direct connected on single base with 15-kva generator. Model D297, 4 cyl with maximum rating of 44 hp, may have drive equipment similar to Model D148.



The Ideal "TOP KICK"

Many an industrial commander, in these critical times, notes with keen satisfaction the smooth, well drilled performance of his steam power plant—and gives deserved credit to his "top sergeant": A Hays Combustion Control System.

Here, indeed is a seasoned, capable veteran, skilled at getting utmost efficiency out of the equipment he commands.

Automatically, "The All-Electric Way" Hays system controls combustion. It's made to do that. It regulates all combustion elements—measures each variation and corrects instantly—measures the correction: *maintains the right balance.*

With the nation's war effort putting extra demands on present steam power equipment, Hays Combustion Control Systems are doing an extraordinary job—stretching steam capacity, *safely;* getting the utmost out of existing boiler room equipment, *safely;* saving man-hours, saving operating costs.

To enlist this veteran in your own service, send for the Hays Combustion Control Catalog—it is full of pertinent steam-power data.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

SANTOSITE...

IMMEDIATE DELIVERY WITHOUT PRIORITIES!

THE SURE, ECONOMICAL WAY TO GUARD BOILERS AGAINST OXYGEN CORROSION

SANTOSITE is again available, and we feel sure there will be ample supplies from now on. You, therefore, can be sure that your boiler feed water is free of dissolved oxygen and, thereby, protect it against oxygen corrosion. It has been demonstrated over the years that thirty parts of Santosite per million parts of water were ample. It has also been proved that Santosite is a valuable adjunct to mechanical deaerating equipment to give assurance against oxygen corrosion.

Santosite, an anhydrous crystalline product is easy to handle, store and apply.

Complete details on the application of Santosite to your boiler feed water will be sent promptly upon request to: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, St. Louis, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal, Toronto.

"E" for Excellence—The Army-Navy "E" burgee with two stars, "representing recognition by the Army and the Navy of especially meritorious production of war materials" over a two-year period, flies over Monsanto's executive offices in St. Louis and over Monsanto plants at Anniston, Ala., and Monsanto, Tenn. The Army-Navy Production Award also has been won by five Monsanto plants at St. Louis, Mo., Monsanto, Ill., Karnack, Texas, and Springfield, Mass.

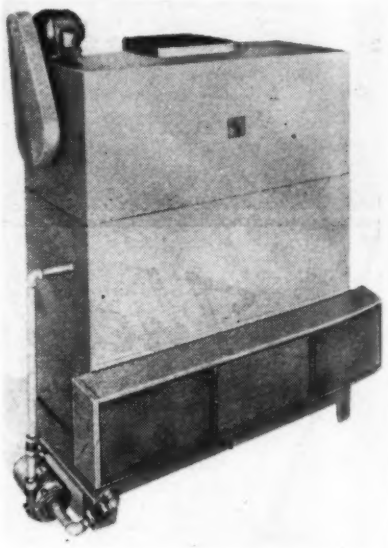
MONSANTO CHEMICALS

SERVING INDUSTRY...WHICH SERVES MANKIND

Special feature is that flywheel, clutch, generator or marine gears may be installed on either or both ends, provided a radiator is not used. For electric power and light, use Model D-97 to power 30-kva generator. *Climax Engineering Co, Clinton, Iowa.*

Welder

AMPAC "400" AMP WELDER handles ¼-in. electrodes on 24-hr continuous operation, and provides ample capacity for rods up to ⅜ in., when needed. Range of 50 to 500 amp is covered by the Ampac "400," with power-factor correction available. Outstanding features are low idling loss, high power factor, high efficiency and excellent welding characteristics over entire range, according to manufacturer. Welder requires only eight turns of control handle for entire range. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*



Evaporative Condensers

WAT-R-MISER LINE incorporates built-in air filters to protect against impurities in cooling system. Units effect heat transfer by water evaporation in a continuously moving airstream. Air filter, which is standard equipment on all models, is made of rust-proof metal easily removed for washing or cleaning. *Drayer & Hanson, Inc, 738 E Pico St, Los Angeles, 21, Calif.*

Temporary Protective Coating

THIN FILM, applied by brush or dip, air-dries at a maximum of 15 min, depending on atmospheric conditions. Product eliminates greasing and other methods, such as packing in pliofilm bags. For coating removal, strip it off easily by hand without use of solvents. Addi-

ROCKBESTOS A.V.C.

Maintains Production Schedules with a Permanent Insulation that Won't ROT or BAKE BRITTLE

Why Rockbestos Permanent Insulation Prevents Premature Wire Failure

Rockbestos A.V.C. Power Cable, illustrated*, 600 to 5000 volts, No. 18 A.W.G. to 1,000 MCM. Underwriters' and N.E. Code, Type AVA, maximum operating temperature 110°C., has this permanently insulated construction.

1. The conductor is permanently centered in helically applied insulation that will not flow, migrate, dry out, crack or rot.

2. Felted asbestos insulation withstands conductor-heating overloads and won't burn even when exposed to copper-melting arcs.

3. Lubricated varnished cambric for high-dielectric strength and added moisture resistance, protected from heat, flame and oxidation between two felted asbestos walls.

4. Felted asbestos insulation impregnated with heat, flame, and moisture-resisting compounds will not dry out, become brittle, or burn. Also serves as a heat-barrier against high ambient temperatures.

5. A tough, rugged impregnated asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

**One of 122 different wires and cables developed for severe operating conditions by Rockbestos.*

RESISTS moisture, oil, grease and fumes. WON'T bake brittle, burn, flow or rot.

Baking, withering heat causes more failures in circuits running around furnaces, lehrs, kilns, steel mills, power plants, steam tunnels, etc., than any other trouble maker. It dries out the insulation, opens cracks to moisture, sets up shorts, rewiring jobs, equipment and production outage—unless the wire is *permanently insulated* like Rockbestos A.V.C. This construction with its laminated asbestos and varnished cambric insulation, covered with a tough asbestos braid, won't bake brittle, crack, swell, flow or rot under heat and is also resistant to moisture, oil, grease, corrosive fumes and flame. Other Rockbestos wires, cables and cords designed for severe operating conditions are available in our line of 122 standard constructions. For information or recommendations write to nearest branch or:

Rockbestos Products Corp., 919 Nicoll St., New Haven 4, Conn.

For Victory—Invest in U. S. War Bonds

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE

For positive control of continuous blow-down

A NEW way for you to prevent heat waste by accurately controlling the flow rate of continuous blow-down is available in the latest Fischer & Porter development, the Magna-Bond Rotameter. This meter is all metal (no glass) and is completely enclosed. The position of the rotameter float is indicated externally by means of a permanent magnetic clutch. The Magna-Bond may be obtained as a plain flow rate indicator, or as recorder, or recorder-controller. It may also be equipped with our new high accuracy Magna-Count integrator for totalizing the flow. The interesting details are all given in our latest bulletin on recording and controlling rotameters, #50-A. Just write if you wish a copy.

You will be able to see our latest developments at BOOTH 304-306—CHEM SHOW, NEW YORK, DEC. 6 to 11

FISCHER & PORTER CO. 6011 County Line Road HATBORO, PA.

tional advantage claimed by maker is that part requires no cleaning other than stripping to be ready for use. Coating covers all finishes and is manufactured in two forms. No. 002 gives short-term protection; No. 003 is for long periods of storage. *INSLX Co, 857 Meeker Ave, Brooklyn, N. Y.*

Dimout Shade

PLASTIC SHADE for porcelain or other sockets, requires socket extension which has Uno-shade holder thread. Maker claims it renders a permanently shielded 90-deg cone of light from a non-reflecting surface. *Laduby Co, 505 Grand Ave, New Haven, 5, Conn.*

Metal Coating

PROCESS requires electrolyte, metal cleaner, and applicator. Plating current is obtained from dry cells, storage battery, "Rapid" plating rectifier, or any convenient source supplying dc current at 3 to 6 v. *Rapid Electroplating Process, Inc., 1414 S Wabash Ave, Chicago, 5, Ill.*

Fluorescent Lamp Ballast

AIR-COOLED TYPE fluorescent lamp ballasts designed for exposed mounting on fluorescent lamp fixtures. Units require no special installation devices and are built in ratings of 40 to 100 watts for 1-, 2-, 3- and 4-lamp fixtures. They differ from standard design in that leads are brought out through outlets in base plate. *The Acme Electric & Manufacturing Co, Cuba, N. Y.*

Lubricating Oil

DETERGENT LUBRICATING OIL for low-speed diesel engines developed to prevent ring sticking, piston scuffing, and excessive sludge and gum deposits. Detergency results from an additive which is both a detergent and an oxidation inhibitor. Company claims film coats carbon and dirt, prevents particles from sticking and holds them in suspension until they are trapped by filter or drained from engine. *Standard Oil Co of Indiana, Chicago, Ill.*

Thermometer

TAG INDUSTRIAL THERMOMETER has a plastic-case front and yellow back. Plastic case reduces weight of instrument and yellow-back lens-front thermometer tubing offers color contrast with the mercury. Black finish protects instrument against corrosion. *C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.*

Now SEAL both OIL and WATER

NEW JOHN CRANE PLASTIC LEAD SEAL FOR Heavy duty Insoluble

PIPE-LINE, REFINERY, MARINE, POWER, CHEMICAL, AVIATION, INDUSTRIAL USES

Temperatures to 600° F. . . . Pressures to 4000 pounds per sq. in.

One "easy-spread" application and your sealing job is done—for sure, for years! John Crane new lead seal is plastic: will not set or seize nor harden under temperature extremes. Joints may be broken after years of service and remade without scraping. Protects threads, eliminates corrosion. Prevents scoring and galling. Adjusts to all clearances. May be applied to cork, paper, asbestos, copper, aluminum, lead, steel . . . John Crane Insoluble Plastic Lead Seal is a scientific laboratory formula made from pulverized metallic lead carried in a special vehicle: smooth, easy-spreading, fast-flowing. It is chemically pure: no red lead, clay filler or dope. An insoluble lubricant as well as a seal . . . Send for prices, sample and literature. Packed in ½, 3 and 5 pounds ready for use.

SERVICES: Oil, gasoline, kerosene, benzol, propane, butane, bottled gases, steam, water, hydrocarbons, aqueous solutions, ammonia, CO_2, toxic and inflammable gases, lutings in plugs.

EQUIPMENT: Threaded joints, flanges and gaskets, nuts, caps, valves, plug valve stems and seats, safety fuse plugs, screwed fittings, pumps, cylinder heads, boilers, compressors, stills, tanks, towers, gas stoves, etc., etc.

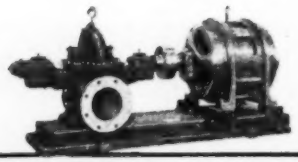
CRANE PACKING COMPANY, 1800 CUYLER AVENUE, CHICAGO

Branches: Baltimore, Boston, Buffalo, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Tulsa

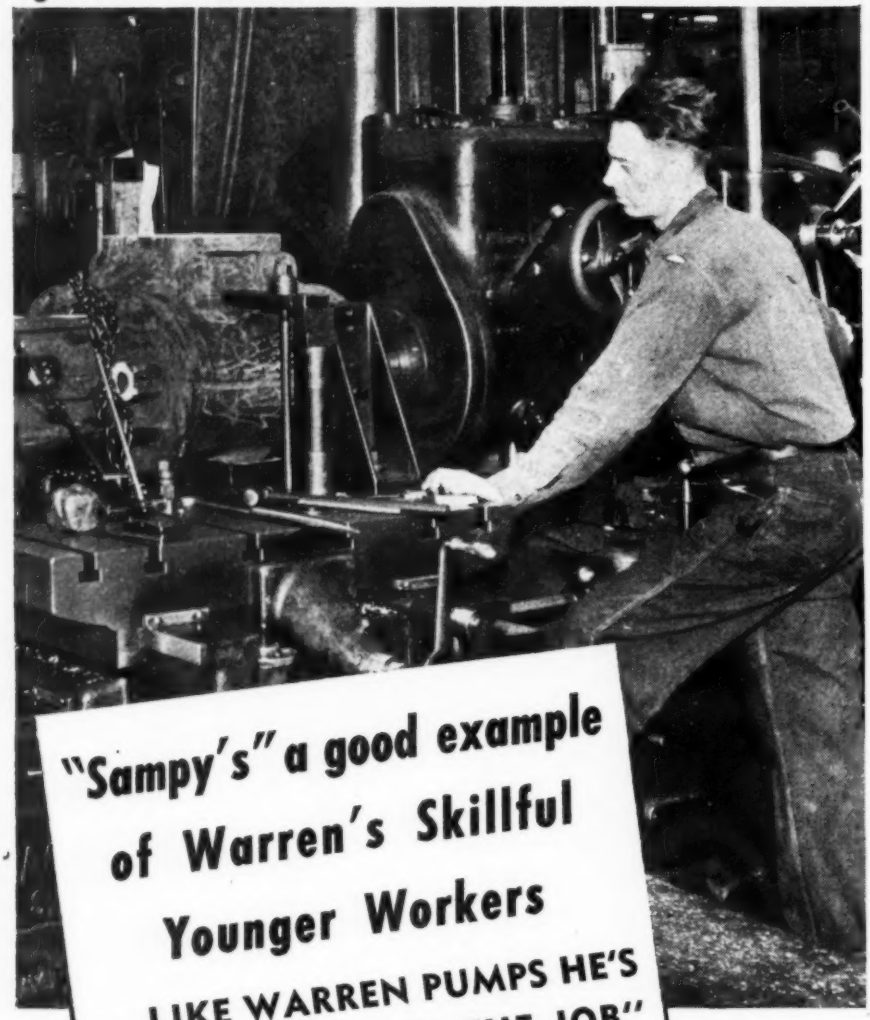
Crane Packing Co., Ltd., Hamilton, Ontario, Canada

Branches: Montreal, Toronto, Vancouver

Extensively used by ✪ LEADING AIRPLANE BUILDERS



Fighters on the WARREN PUMP Production Front. No. 7 of a Series



"Sampy's" a good example of Warren's Skillful Younger Workers

... LIKE WARREN PUMPS HE'S "BUILT TO FIT THE JOB"

Among our younger but thoroughly experienced pump makers is Harold A. Sampson.

"Sampy", who operates a Horizontal Boring Mill, handling pump casings and other parts up to 30" sizes, has 14 years of Warren Pump experience behind him. He takes as deep pride in turning out the quality pumps that "are built to fit the job" as the skilled Warren Pump Makers who have been on the job for 20, 30 or even 40 years.

It is this pride that these skilled men take in Warren Pumps that enable Warren equipment to perform so faithfully in the gruelling 24 hour duty demanded in war plants or the do-or-die duty asked for in the United States Navy, Coast Guard and Merchant Marine. It is this pride that enabled these Warren Workers to win the Army-Navy "E" Award.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

Engineers' Books

(Continued from page 128)

tric and magnetic laws as background for the study of circuits; (2) review the student's previous study of electricity and magnetism. Chapter VI is a study of the step-by-step solution of electric circuits. Succeeding chapters develop the electric-circuit theory, discuss electric-transient theory from the physical viewpoint, and supply the tools for the numerical solution of communication and power-network problems. The last chapter, on Fourier analysis of irregular waves, details a number of methods of determining the harmonic coefficients.

Patents

PATENT LAW (1943) *By C H Biesterfeld, member of New York Bar and Bar of District of Columbia. Published by John Wiley and Sons, Inc., 440 Fourth Ave, New York, N. Y. 225 pages, 5½x 8¼ in., cloth binding. Price* $2.75.

This book is intended to be helpful to those more or less regularly confronted with patent-law questions arising out of their daily technical work. It presents the various phases of patent law and explains the basic principle or rule underlying each phase. The principles are illustrated by the citation of leading cases and by quotations from the decisions.

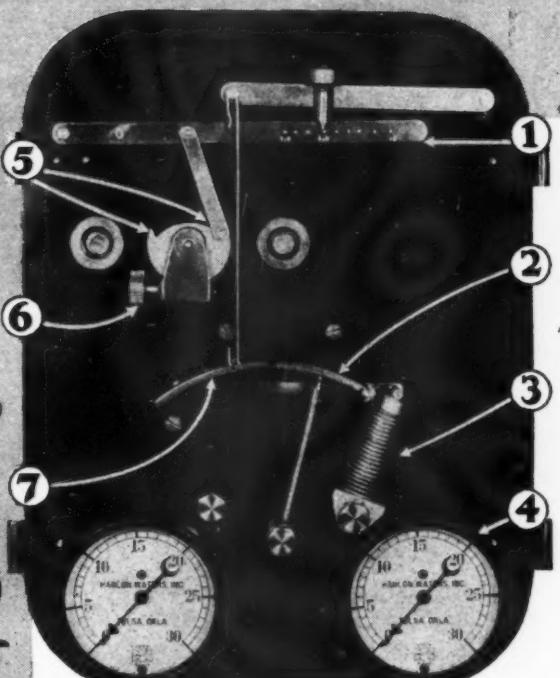
The author has given specal attention to recent decisions of the courts, even to the exclusion of older cases where they would not assist in showing current legal trends. The author also draws particular attention to the fact that the courts recently have ruled invalid about 80% of patents coming before them, which makes it particularly important for the engineer and student to question the potential validity of any prospective patent.

In addition to a comprehensive treatment of the questions connected with invention, patent claims, patent application and matters of infringement, the book also includes material on licenses, trade secrets, patent litigation and searches.

Radio

FUNDAMENTALS OF RADIO (1943) *By L O Gorder, consulting radio engineer; Kenneth A Hathaway, managing director of radio parts, Manufacturers' National Trade Show; and Carl H Dunlap,*

Ask the men WHO USE THEM!



H-W Type 1410 *Level Control Pilot*

(1) Specific gravity index scale setting from 0.10 to 2.0.

(2) WIDE THROTTLING RANGE adjustment from Zero to 300%—setting in exact relation to specific gravity setting.

(3) Long life bellows, operating throttle arm.

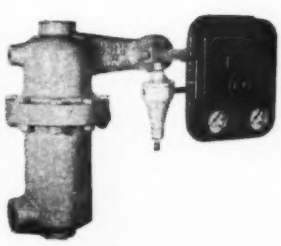
(4) Straight line pilot characteristic of pressure output to diaphragm vs. level variation.

(5) Simplified-Reversibility.

(6) Adjustment for height of Level Control.

(7) "Snap Action" settings on Pilot without use of any additional parts or special tools.

Equipped with the popular H-W Type 245 Supply Regulator.



Wide swinging door—easy accessibility of all parts.

Mountable on any H-W Type 850 Displacement Level Control.

H-W New Type 1410 Level Control Pilot is especially designed to meet requirements for a Level Control Pilot having a VERY WIDE "Throttling Range"—EXACT in its relation to the specific gravity of the liquids handled in the system. Important for indicating or recording level service where the displacement float is used to indicate position of level in vessels where highly corrosive liquids make continuous use of gauge glasses impossible.

Features of the Type 1410 Level Control assure performance matching other H-W Control Equipment used throughout the Refining, Chemical, Synthetic, Gasoline, Recycling and Power industries.

THE LEVEL CONTROLLER WITH **no** STUFFING BOX LEAKAGE FRICTION

FOR EVERY CONTROL PROBLEM
STANDARD FOR *Performance*

HANLON-WATERS INC. H-W

Hanlon-Waters, Inc.
TULSA, OKLAHOMA

Information on all HANLON-WATERS Equipment is available at representative nearest you.

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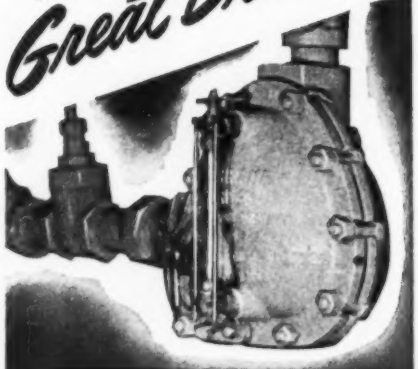
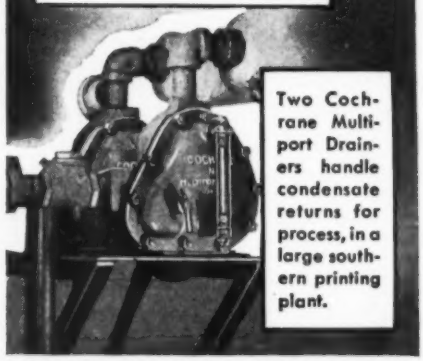
Tribute to a Great Drainer

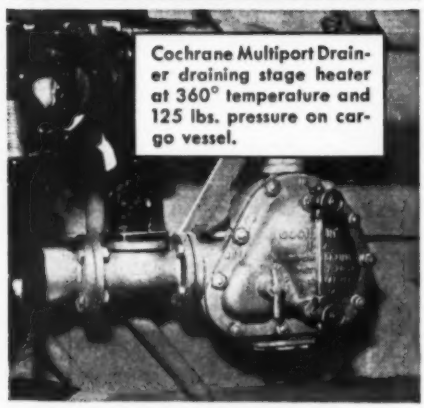


"These traps" (Cochrane Multiport Drainers) "discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

— *Steam Engineer of large New England paper mill.*



Two Cochrane Multiport Drainers handle condensate returns for process, in a large southern printing plant.



Cochrane Multiport Drainer draining stage heater at 360° temperature and 125 lbs. pressure on cargo vessel.

Write for a copy of Publication 2925.

COCHRANE CORPORATION
3106 N. 17th Street, Philadelphia 32, Pa.

COCHRANE
DRAINERS

head, electrical engineering department, American School. Published by American Technical Society, Drexel Ave, at 58th St, Chicago, Ill. 373 pages, 5½x8 in., 228 illustrations, numerous tables, cloth binding. Price $2.00.

Power engineers are more and more coming in contact with electronic equipment. Unfortunately, literature suitable to their purpose has not been plentiful. This book helps to correct the condition. Written for those preparing for war service, it is both simple and practical. Over half the text is devoted to fundamentals of electricity and magnetism, descriptions of electronic equipment and explanations of simple electronic circuits. All this material could well be part of any good practical book on electronics, therefore of interest to everyone who has anything to do with such equipment. Last half of the book deals with radio equipment and circuits, but much of the material is useful to those interested in industrial electronics. The book closes with a 17-page glossary of electric and electronic terms and a compilation of useful tables.

Research

THE CHEMICAL BACKGROUND FOR ENGINE RESEARCH (1943) *Edited by R E Burk, Director of Research, The Standard Oil Company of Ohio, and Oliver Grummitt, Western Reserve University. Published by Interscience Publishers Inc, New York, N. Y. 297 pages 6 x 9 in., illustrated. Price* $3.50.

Growing out of a series of lectures presented at Western Reserve University, this book presents technical discussions by six outstanding scientists of the various chemical phases of internal-combustion-engine development. Dr E F Fiock, senior physicist, automotive power plants section, National Bureau of Standards, presents a survey of combustion research; Major Bernard Lewis, formerly senior physical chemist, U. S. Bureau of Mines, discusses the experimental side of combustion research in engines; Dr Frederick D Rossini, chief of the section on thermochemistry and petroleum chemistry, National Bureau of Standards, deals with the chemical thermodynamics of hydrocarbons; Dr Frank C Whitmore, dean of the School of Chemistry and Physics, Pennsylvania State College, describes synthetic methods for hydrocarbons; Dr Guenther von Elbe, U. S. Bureau of Mines, explains the kinetics of flame and combustion; and Dr Otto Beeck, associate director of research, Shell Development Laboratories, pre-

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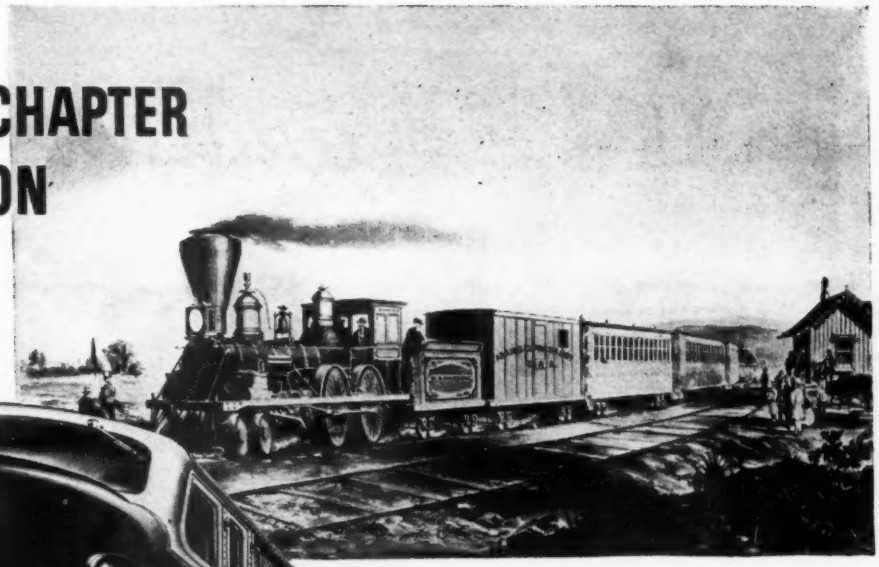
WRITING A NEW CHAPTER IN TRANSPORTATION



A new era of bygone days was represented by the "American Express Train" of 1855, here pictured by the famous lithographer, Nathaniel Currier. In 1869, that era culminated in the completion of the first transcontinental railroad.

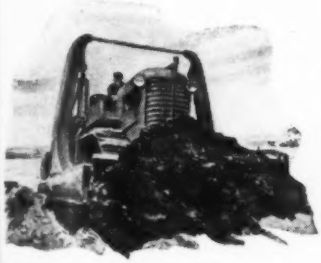
Railroads are facing their biggest test in moving today's record volume of freight. GM Diesel freight locomotives are helping the Seaboard to do its part in meeting this emergency.

The war record of the railroads is a remarkable story of transportation.

And potent new factors in writing this story are General Motors Diesel Locomotives.

Tough, tireless freight Diesels are hauling war loads faster, and with rare economy of precious fuel.

They are adding a new chapter to America's story of railroading, and demonstrating that today's achievements are the first great step in a new era of transportation.



Reconstruction and new construction are going to need plenty of this hard-hitting, easy-on-fuel power. With normal refinement and development speeded up by war, with production expanded, GM Diesels will be ready to serve in more fields and in more ways than ever.

★

BACK THE ATTACK—
WITH WAR BONDS

GM
GENERAL MOTORS
DIESEL POWER

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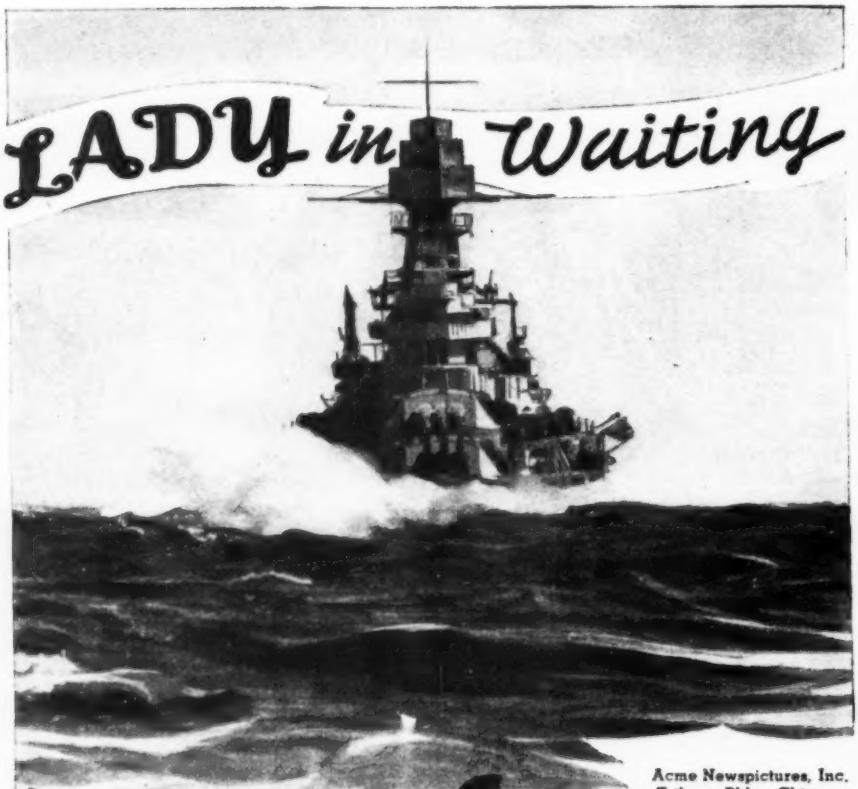
ENGINES..150 to 2000 H.P...CLEVELAND DIESEL ENGINE DIVISION, Cleveland, Ohio

ENGINES.....15 to 250 H.P.....DETROIT DIESEL ENGINE DIVISION, Detroit, Mich.



Acme Newspictures, Inc.
Tribune Bldg., Chicago

Looking for TROUBLE!

HERE'S one of Uncle Sam's first-line fighting ships on the prowl! At a glance she appears to be a lady from stem to stern—from crows nest to keel, but she has a nasty disposition when aroused and becomes a destructive "she-devil" when axis marauders are encountered.

Coe Drainators contribute much to her effectiveness and efficiency. On many types of steam equipment on shipboard they eliminate condensate and air continuously without the necessity of adjustment or the usual frequent repairs.

Drainator features, found so valuable in thousands of domestic installations, are especially desirable on shipboard. Having no moving parts, Drainator's operation remains at peak efficiency regardless of how violently the ship may roll or plunge.

The COE MANUFACTURING Co.
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DRAINATOR • THE ADVANCED STEAM TRAP

Write for a copy of Bulletin No. 903-A and learn how Drainators will solve your condensate drainage problems.

sents some physiochemical aspects of lubrication.

Research engineers in the internal-combustion-engine field will find this volume of considerable value as a summing up by specialists of the basic chemical foundation underlying most advanced work in engine development.

Cable Joints

CABLE OPERATION 1941 (1943) *Published by Edison Electric Institute, 420 Lexington Ave, New York, N. Y. 22 pages, 8½x11½ in., 3 illustrations, 25 tables, paper cover. Price* $0.50 *to members and* $1.25 *to nonmembers in U. S. A., foreign countries* $1.35.

This is a joint report of the committee on power distribution, Association of Edison Illuminating Companies and transmission and distribution committee Edison Electric Institute. Continuing the policy initiated with last year's report, the present one combines the essential features of high-voltage cable operation studies carried on separately by the two committees. The number of contributors this year (17) is one less than reported last year. For the third consecutive year trouble rate for paper-insulated duct-lay cable has been constant at 6.9. There was an increase in the failure rate of 4.7 to 5.1, which was offset by a decrease in the removal rate.

Slide Rule

SLIDE RULE SIMPLIFIED (1943) *By Charles O Harris, assistant professor of mechanics, Illinois Institute of Technology. Published by American Technical Society, Drexel Ave at 58th St, Chicago, Ill. 266 pages, 5½x8 in., 58 illustrations, cloth binding. Price* $3.50 *with slide rule or* $2.50 *without.*

Practically everyone in any way connected with engineering work should know how to use a slide rule because it is a great timesaver in making mathematical calculations. However, many people who would like to use this device are frightened away by the idea that its operation is complicated and difficult to master. This book is designed to dispel the idea. A feature is the practical instruction on how to read the different scales accurately and thus forestall serious errors. Each type of calculation, such as multiplication, division, combinations of multiplication and division, the square and square root, the cube and cube root, and other operations are carefully explained so that they can be mastered by the reader who studies alone as by those in a classroom.

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OVER 20,000,000 horse-power bearing the Crocker-Wheeler name is serving the war effort, on land and sea.

Many of these motors and generators were built a generation ago . . . some were made in 1943. But all of them were built to stand up under unusual conditions.

Watching over them is a corps of carefully trained field engineers, to whom the difficult and the unusual are all in a day's work.

We can make immediate deliveries on some types . . . consult your nearest Crocker-Wheeler office, or wire us.

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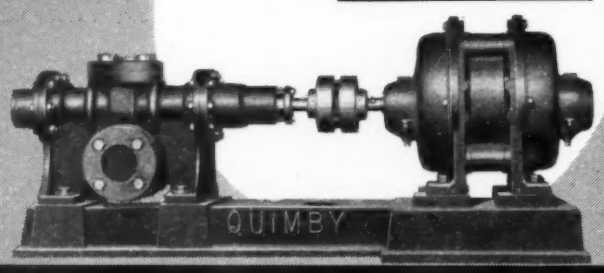
No metal-to-metal contact except at bearings and driving gears. Clearance between impeller elements, and between impellers and casing, eliminates wear and insures *constant efficiency.*



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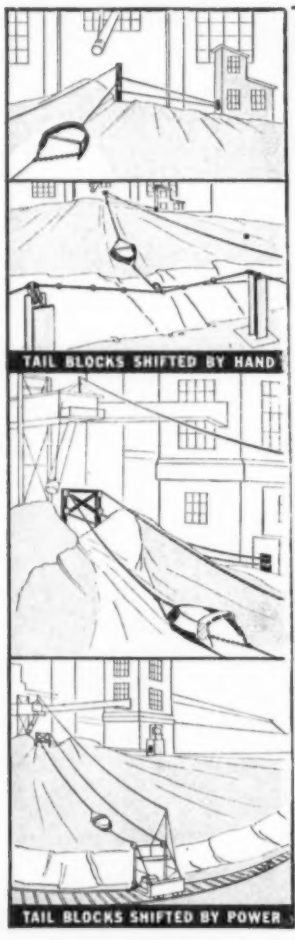


How Sauerman Scrapers Simplify Coal Handling

The Sauerman Power Drag Scraper is a one-man machine that serves as a self-loading conveyor with large handling capacity and long reach, assuring full use of all ground space. The dominant feature of this machine is a cable-controlled, bottomless bucket that rides on the material it is to move. Pulled forward, the bucket loads and pulled backward it empties.

In storing, coal is dumped in front of a head post and is spread out from this initial pile by the bucket which stacks one layer of coal on top of another to any required height, forming a flat-top pile that is perfectly homogeneous and immune to spontaneous combustion. In reclaiming, the bucket is turned around and the coal hauled back.

Sauerman scraper installations in general are divided into two types: (a) With hand shifted tail-blocks; (b) With tail-blocks shifted by power, utilizing a self-propelled tail tower. The two types of installations are shown in the sketches at left.

The Remarkable "Crescent" Bucket

Picture shows a Sauerman "Crescent" scraper bucket dumping its load of coal at outer rim of wide storage pile. In action, this streamline bucket encloses its load and virtually "floats" across the pile. The load is dumped automatically at any designated point and the bucket returns at high speed to get another load. Coming or going, this bucket rides lightly across the surface of the pile and accomplishes its work with a small expenditure of power.

WRITE FOR CATALOG

SAUERMAN BROS., Inc.
562 SOUTH CLINTON ST., CHICAGO 7, ILL.

Power Lines

(*Continued from page* 134)

WPB to obtain maximum production. Previous schedules cover concrete-reinforcement steel, structural shapes, barbed wire, fence posts, tubular goods and many other steel products. The new specifications are part of WPB's program to reduce number of types and sizes of steel products:

(1) Specifications and standard sizes for **steel-pressure pipe** used in power plants and certain industrial plants. Specifications cover both carbon and alloy steel piping in lap-welded, seamless, electric-resistance-welded and fusion-welded grades. Current production agrees substantially with the schedule.

(2) Steel-pressure tubes include boiler, cracking still, heat exchanger, condenser and superheater tubes. They are important for oil, synthetic rubber and chemical production.

(3) Specifications for steel pipe, exclusive of pipe covered by other schedules and specialty items, such as corrugated pipe, dredge pipe, etc. Schedule requires reduction of about 65% in number of sizes and wall thicknesses in various pipe-mill catalogs.

The Government's conservation campaign was opened this fall with electric, gas, water, coal, transportation, communications and oil industries pledged to a voluntary, intensive drive aimed at checking wasteful uses of these commodities. One of the reasons for the drive is the fact that as enemy nations are forced out of the fighting, Allied resources will be needed for their rehabilitation. For example, most if not all the coal shipped to Italy is expected to come from the U. S., because England's coal is already allocated to home war industries and to North Africa.

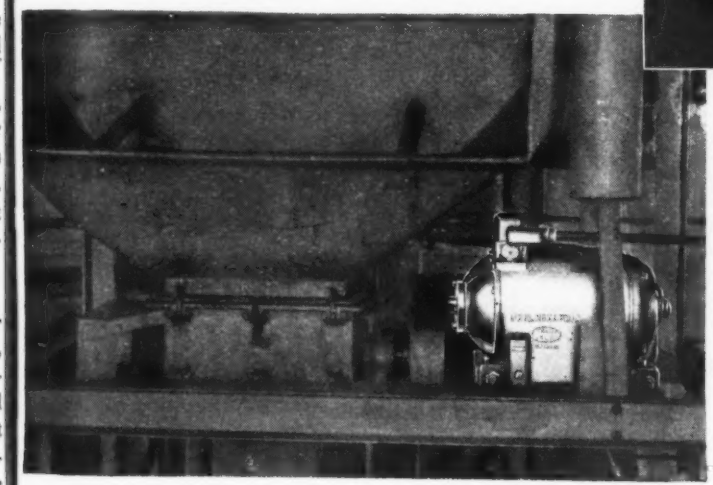
When the war ends, most of the ten million in the armed forces and millions more in war work will want peacetime jobs. **The Committee for Economic Development** has a concrete, workable program, one part of which is to stimulate private business, on a company-by-company basis in each community to plan now for postwar employment. Their goal is 1200–1500 committees, which means CED will be in every town of 10,000 or more persons and in many smaller communities. Through these local committees, they expect to reach most of the two million businessmen who employ one or more

IRREPLACEABLE EQUIPMENT NEEDS THIS EFFICIENT DRIVE WITH THE SAFETY FEATURES

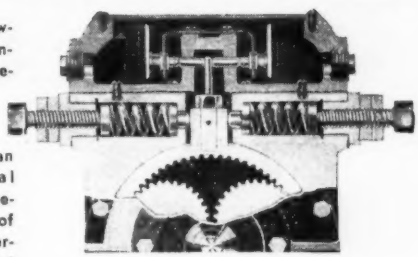
The Philadelphia PlaneTorque MotoReduceR is a self-contained unit, particularly adaptable for driving stokers, conveyors, mixers and other equipment subject to possible jamming or overloading. The PlaneTorque feature is on guard for those emergencies. Automatically and instantly it shuts off the power whenever a predetermined load limit is exceeded. To start the drive again, simply remove the overload.

The PlaneTorque feature is available on both the horizontal and vertical type MotoReduceR. A wide range of horsepowers and ratios to fit all needs.

Get our catalog MR 40 for details.



PHILADELPHIA PLANETORQUE MOTOREDUCER



Cut-away view showing internal construction. PlaneTorque switch responds to overloads more quickly than electrical thermal relays since the mechanical action of the overload operates the cut-out switch directly.

ARMY-NAVY "E"

PHILADELPHIA GEAR WORKS, INC.

INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

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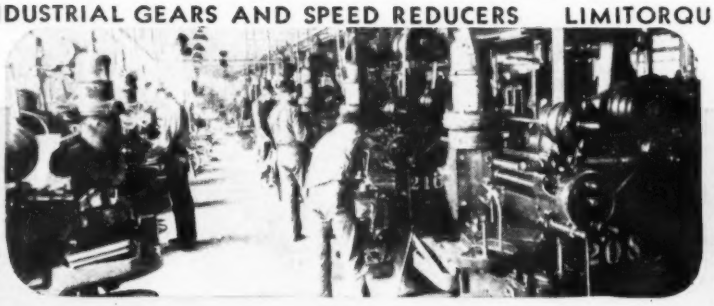
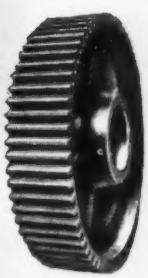
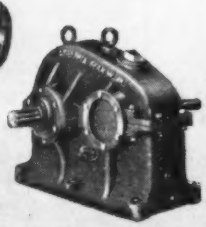


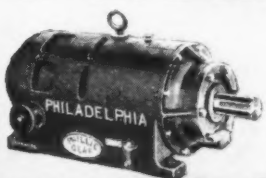
***Philadelphia* LIMITORQUE CONTROL** operates all types of valves, etc., safely, economically, from convenient stations.



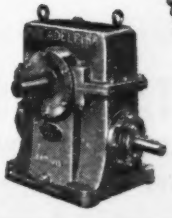
***Philadelphia* GEARS** All types and sizes of industrial gears. Can be supplied in all materials.



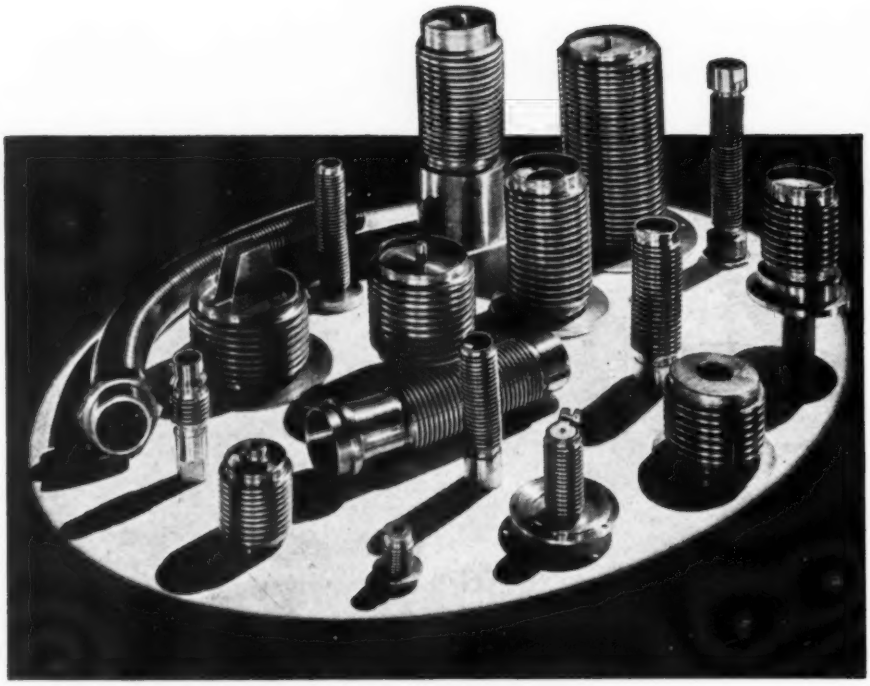
***Philadelphia* HERRINGBONE SPEED REDUCER** for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.



***Philadelphia* MOTOREDUCER** The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.



***Philadelphia* WORM GEAR SPEED REDUCER** right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.



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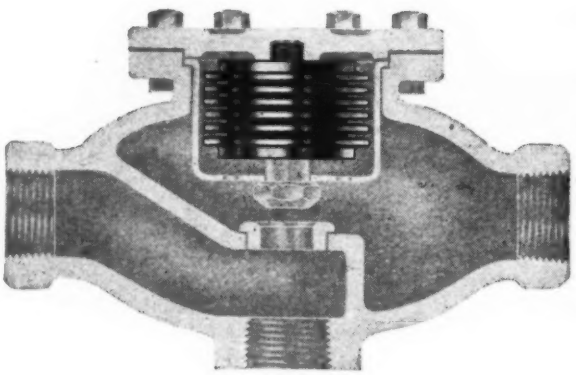
Stainless Steel Bellows

Wherever stainless steel's corrosion resistant qualities and temperature values are required in bellows service, CMH unimetal **circular seam welded** assemblies are filling that need.

No Solder or Flux Required

Long lengths of CMH Bellows are standard production; strength is further enhanced with **multiple ply** assemblies when needed.



Ask for engineering recommendations on specific applications.

CHICAGO METAL HOSE CORPORATION

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persons. But postwar planning for jobs will also require the best brains and imagination of other men in many key positions in industry.

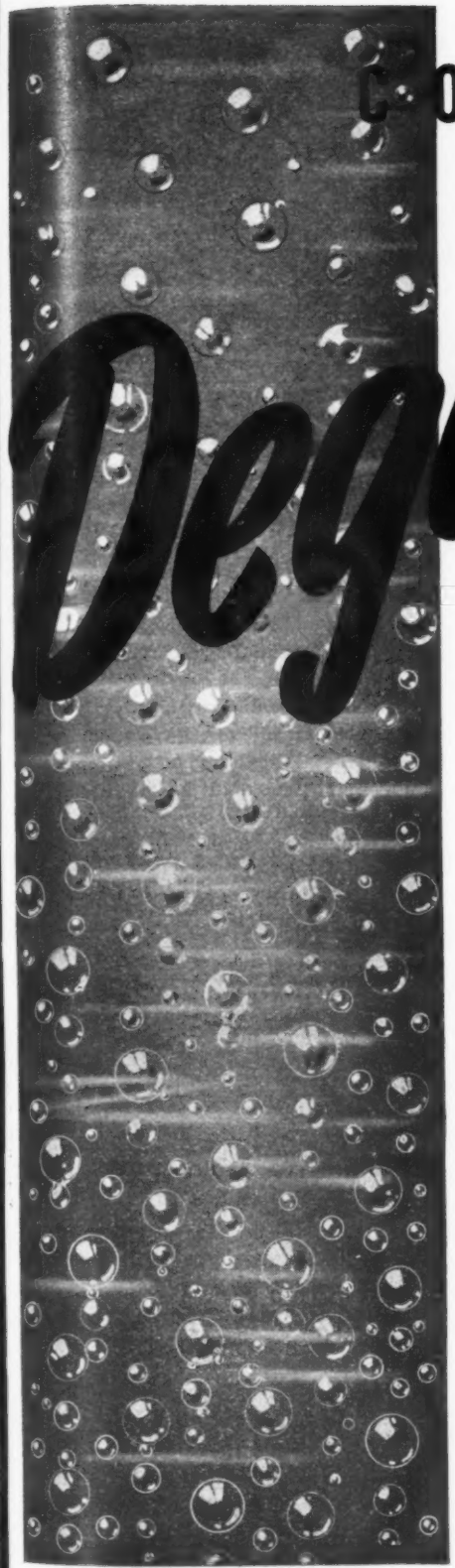
WPB's Component Scheduling Plan, under which component items of critical end products are on the same rigid basis as the end products themselves, has been put on a mandatory basis by inclusion in Order M-293.

Virtually all equipment in a generating or substation and much transmission and distribution equipment is eligible for "frozen schedule" production, which, when approved by WPB, is proof against interference to the immediate advantage of a "rush" program.

Power plants, as programmed by Office of War Utilities, are on the list of six vital programs eligible for the new "frozen" treatment of components. The list, generally considered to contain the most important programs now facing our industrial capacity, includes these programs: ships by the Navy, Maritime Commission and War Dept; advanced and overseas bases by the Navy; combat and transport vehicles by the War Dept; power-generating stations; rubber plants by the Rubber Director; high-octane gasoline plants by the Petroleum Administration for War.

Iron and Steel pop safety valves. Natl Bureau of Standards announces a simplified practice recommendation for these valves. Included are iron body, carbon steel body and alloy steel body, pop safety valves, intended primarily for land steam service. The simplified list will satisfy 95% of the requirements for these valves, considering models, inlet sizes, outlet sizes, connections. The variety will be reduced from about 3000 to 200. Need for the recommendation was apparent when an analysis disclosed that all the needs of claimant agencies could be met only by reducing the variety the industry was called on to make.

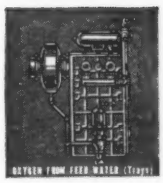
The new National Security Award, established by Office of Civilian Defense, is open to all manufacturing, industrial and utility companies whose protection organizations against fire, sabotage, accidents or possible air attack pass rigid OCD qualifications. Award is a plant certificate and individual cards or lapel insignia for members of the protective organizations. Size of establishment is not a factor. Awards will be made to individual establishments, not on a company-wide basis, and will be withdrawn if standards fall below



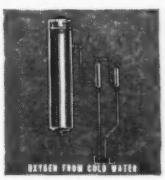
COCHRANE

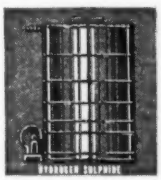
EQUIPMENT FOR THE

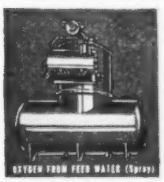
Degasification OF WATER



Cochrane equipment for the degasification of water comprises many types and includes the widest range of sizes and capacities. For the removal of OXYGEN and CARBON DIOXIDE, from boiler feed two types of equipment are available: the tray type Deaerator and the atomizing type. For the removal of OXYGEN FROM COLD WATER, a Cold Water Deaerator of the tray type, operating under vacuum is available. For the removal of CARBON DIOXIDE from cold water, Cochrane supplies a Decarbonater constructed of wood throughout, including wood trays as well as the wood tank. A blower forces air in the bottom of the Decarbonater, which air is vented from the top, scrubbing the water and carrying the carbon dioxide with it. For the removal of HYDROGEN SULPHIDE, an apparatus similar to the Decarbonater is used except that the design takes into account the higher solubility and provides means of controlling pH value. For the removal of AMMONIA, Cochrane furnishes an Ammonia Degasifier, comprising a tray stack of unusual height and utilizing a quantity of steam far in excess of that which can be condensed by the water under treatment.







The above illustrates the range and comprehensiveness of Cochrane equipment for the degasification of water. But Cochrane engineering service does not stop with these designs. Special equipment may be necessary for your own particular problem. We shall be glad to answer your questions.

COCHRANE CORPORATION • 3106 N. 17th ST. • PHILADELPHIA 32, PA.

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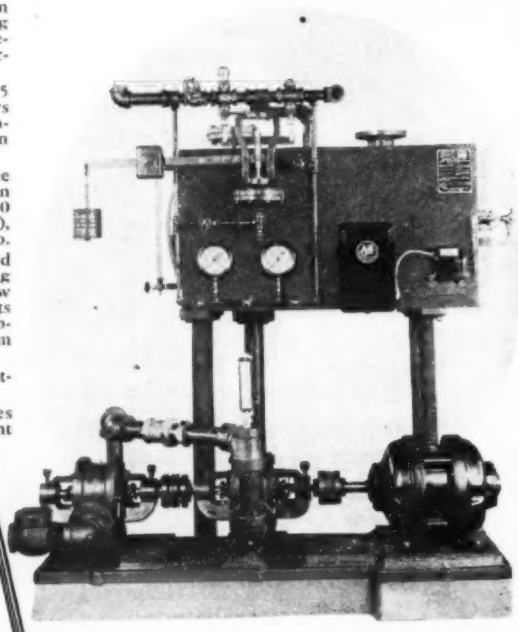
SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

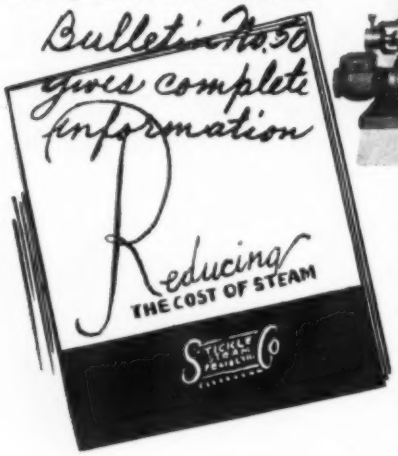
You can release every fifth car of coal you now require to other industry and at the same time add 20% to the capacity of your present boilers

The Stickle Differential Drainage and Boiler Return System Means

LESS FUEL, MORE POWER

1. This Stickle closed pumping system returns condensate from processing units at temperature only 15 to 20 degrees below steam temperature at operating pressure.
2. Example: Condensate of steam at 125 lbs. pressure is returned to boilers at approximately 330 degrees as compared with 210 degrees with open vented system.
3. Any plant using 40 to 200 degree process steam pressures can obtain fuel savings of 15 per cent or more (20 per cent approximate average saving), and increase boiler capacity in same ratio.
4. Additional advantages: Improved operating efficiency for processing units. Elimination of hot water overflow and flash steam wastes. Pumping costs greatly reduced. Steam trap troubles obviated. Maintenance of boilers and steam lines reduced.
5. Installation made without interrupting plant operations.
6. Guaranteed minimum advantages this system will obtain in your plant will be presented without obligation.





● The Stickle Differential Drainage and Boiler Return System is now in use in many plants using steam for cooking, drying and other processing work. In most installations fuel savings alone quickly liquidate investment. The use of this system now contributes to relief of general fuel and power problems. Installed with either steam or electrical pumping units. Above halftone shows electrically driven unit.

THE COMPLETE STICKLE LINE OF STEAM SPECIALTIES

Stickle Open Coil Feed Water Heaters, Deaerating and Non-deaerating types, available small to large sizes. Bulletin No. 117. **Stickle Open Float Steam Traps** described in Bulletin No. 115 (medium and high pressure traps for smaller processing units); Bulletin No. 315 (medium and high pressure traps for larger equipment); Bulletin No. 415 (small to large traps for equipment operating at medium and low pressures and for vacuum service). **Stickle Regulating and Reducing Valves**—three types, single and double-seated, small to large sizes. Bulletins Nos. 235 and 435. **Stickle Triplex Oil and Steam Separators.** Bulletin No. 200.

STICKLE STEAM SPECIALTIES COMPANY
2265 VALLEY AVENUE, INDIANAPOLIS, INDIANA

Red, white and blue certificate depicts joint efforts of industry and Civilian Defense, signed by the Director of OCD

the ones that have been established.

Regional OCD directors will grant awards with OCD Director's concurrence and that of the appropriate State Council. Members of the board to pass final judgment on plant awards include: Percy Bugbee, Natl Fire Protection Assn; Paul L. Hardesty, U. S. Chamber of Commerce; R E Wilson, Natl Bureau for Industrial Protection; George J Richardson, Internatl Assn of Fire Fighters (AFL); Edw S Webb, Natl Safety Council; Carl G Goff, Brotherhood Locomotive Firemen and Enginemen; Thos M Brennan, Natl Assn of Mfgrs.

Companies may request consideration from local Defense Councils by meeting standards based on the establishment's individual requirements, such as: (1) Protection personnel recommended by OCD. (2) Training and enrollment of protection personnel in U. S. Citizens' Defense Corps. (3) Integration and coordination of protection and security with local OCD. (4) Emergency instructions for all employees on proper air raid and emergency warning signals and shelter areas. (5) Excellence in observing regulations on blackouts, dimouts and other local defense.

OCD also furthered its plant security campaign with a program for coordination of post-raid restoration of all utilities. Representatives of several utility industries recently agreed with OCD's Technical Board to recommend to commanders of Citizens' Defense Corps that they invite representatives of public and private utilities to form working groups for that purpose.

Solar Mfg Corp and **Solar Capacitor Sales Corp** announce removal of their general offices to 285 Madison Ave, New York 17, N. Y. from the Bayonne, N. J. plant.

TO OUT-PRODUCE THE AXIS *Now...* TO COMPETE IN PRODUCTION *Tomorrow*

You must have A DEPENDABLE SOURCE OF POWER

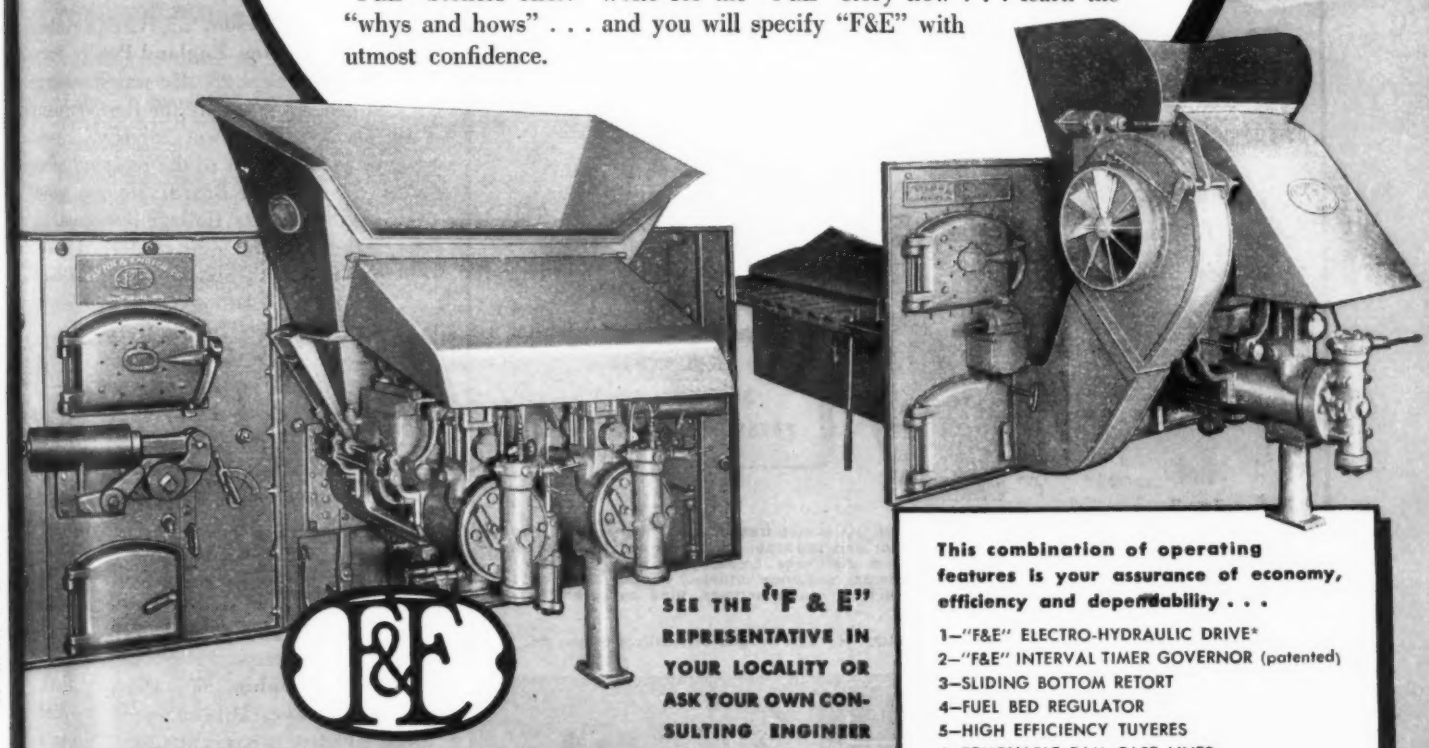
YOU FACE TWO PROBLEMS . . .

Which Equipment? What kind of Fuel?

"F&E" Underfeed Stokers provide the answer to both problems. For you will be burning coal . . . of which there is almost a limitless reserve as yet unmined—and you will be burning it on a stoker that has—for over 25 years—proved its ability to produce extremely low cost steam in practically every type of boiler room.

Engineered for efficiency and economical operation—ruggedly built to give years of hard service—"F&E" Underfeed Stokers will give you the kind of fuel-burning equipment that is essential to profitable and successful boiler-room operation.

If your steam requirements are as high as 40,000 lbs. of steam per hour or as low as 1000 lbs. of steam per hour . . . whether your boilers provide power or heat . . . investigate the advantages that coal-burning "F&E" Stokers offer. Write for the "F&E" story now . . . learn the "whys and hows" . . . and you will specify "F&E" with utmost confidence.



SEE THE "F & E" REPRESENTATIVE IN YOUR LOCALITY OR ASK YOUR OWN CONSULTING ENGINEER

This combination of operating features is your assurance of economy, efficiency and dependability . . .

1—"F&E" ELECTRO-HYDRAULIC DRIVE*
2—"F&E" INTERVAL TIMER GOVERNOR (patented)
3—SLIDING BOTTOM RETORT
4—FUEL BED REGULATOR
5—HIGH EFFICIENCY TUYERES
6—REMOVABLE RAM CASE LINER
* Steam Drive available

Plus

Universal acceptance by exacting mechanical engineers and users

Plus

Enviable performance records as proved by evaporative tests during actual operation.

UNDERFEED STOKERS

Anthracite and Bituminous

FLYNN & EMRICH CO.
Established 1842
BALTIMORE—2, MARYLAND
Representatives in Principal Cities

THE BURNING END

THAT ENDS MANY COMMON STOKER FAULTS: *engineered by Frederick!*

Frederick Stokers have *more active grate surface,* without dead plates . . . maintain a low combustion rate per square foot of area!
The specially designed tuyeres have air ports so arranged and proportioned as to insure complete air distribution and maximum combustion efficiency.
And, the wind-box is enclosed to simplify and make a neater installation, and to eliminate efficiency loss through leaky brickwork. *Two* cleanout doors are provided to allow thorough cleaning *both sides* of the grate area.
Yes, the new Frederick Stokers are DIFFERENT! A long list of original features distinguish them. Many common stoker problems are solved by them. And, if you're looking for maximum thrift, convenience and efficiency, we suggest you investigate. All details upon request; no obligation.

FREDERICK INDUSTRIAL STOKERS

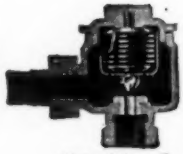
The FREDERICK IRON & STEEL CO.
Eighth and East Sts., Frederick, Maryland

Centrifugal Pumps for All Purposes

PREVENT freeze-ups!

Install Non-Freezing NICHOLSON Industrial THERMOSTATIC TRAPS

Type A



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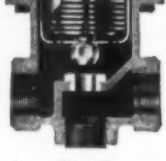

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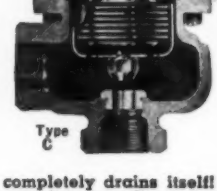


Type C

FIVE TYPES
SIZES ¼" TO 2"
PRESSURES TO 225 LBS.

HERE IS A TRAP that completely drains itself! It is non-freezing . . . non-air-binding . . . non-dribbling . . . requires no adjustment and prevents water logging. NICHOLSON Industrial Thermostatic Traps provide a discharge capacity two to six times greater than average traps—assuring maximum drainage efficiency and increased production through better circulation of steam in water heaters, pipe coils, kettles, dryers, cookers, etc.

Bulletin No. 843 • W. H. NICHOLSON & CO. • 125 Oregon St., Wilkes-Barre, Pa.

NICHOLSON *Traps*

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼ ▼ ▼

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

CURRENT ARMY-NAVY AWARDS

Army-Navy "E" awards have been conferred on four industrial plants: The Cleveland Tractor Co, recently; Craftsweld Equipment Corp, Sept 21; Hazeltine Electronics Corp, Sept 24; Nash-Kelvinator Corp, Propeller Division, Sept 17.

White star added to Army-Navy "E" pennant: Cutler-Hammer Inc, recently; Diebold Inc, recently.

Second white star on Army-Navy "E" pennant: Buffalo Pumps Inc, Aug. 18.

Gold star on Maritime "M" pennant awarded to three plants: Edward Valve & Mfg Co, Inc, recently; Jenkins Bros, recently; Trill Indicator Co, Sept 27.

OBITUARIES

Robert H Jameson, 52, vice-president and director, **New England Power Service Co,** died Sept 23. He was in charge of industrial relations for the company and served as power industry representative on panels of the regional office of the War Labor Board. He was graduated from Tufts College Engineering School, 1913, and was a sales engineer before becoming manager of Marlboro Electric Co, Westboro Gas & Electric Co and Marlboro-Hudson Gas Co.

James E McMahon, manager, water-fog sales dept, **Rockwood Sprinkler Co,** Worcester, Mass., died on Sept 1 at the age of 49. He was formerly sales manager, Graton and Knight Co.

Stuart J Saks, 52, president of **Morris Machine Works,** Baldwinsville, N. Y., died Sept. 13. He joined Morris Machine Works about three years ago.

Robert W Suhm, 60, vice-president, **Suhm Co, Inc,** Milwaukee, Wis., died Aug 23 after a heart attack. He was a member of the Natl Assn of Power Engineers, Milwaukee.

Ernest J Berggren, 80, oldest of the Edison pioneers and last surviving member of the group that worked with the

(Official U. S. Navy Photo)

Pomona Pumps Used for Navy's Greatest Salvage Job!

Probably never in the history of this nation has a more desperate battle against time been waged than in the operations shown here... the U. S. Navy's raising of sunken warships at Pearl Harbor. The size of the project and the speed and efficiency with which it was accomplished make it one of the great engineering feats of all time...

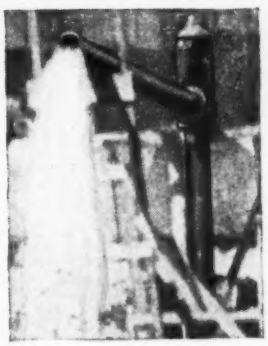
This official Navy photograph shows one phase of this grim race... the job of dewatering and raising the giant warships. Here was a pumping operation involving unusual difficulties... a problem of removing millions of gallons of sea water in great volume and without interruption of flow... *corrosive* water, mixed with oil scum from burst fuel tanks... water laden with harbor muck, gritty sands and rust ... *the toughest kind of a pumping job.* Added to this—working space was extremely limited, and time so precious that none could be wasted on equipment breakdowns!

High up on a column pipe in the photo above you can see the pump that the Navy used for this tough dewatering job—A POMONA PUMP!

What has this to do with YOUR pumping operations? Simply this... when the chips are down and there's a pumping job to do—and do with *maximum dependability, speed and efficiency*—Pomonas are the pumps to use. So why be satisfied with anything less than Pomona performance on ANY pumping operation? **Let your nearby Pomona distributor study YOUR pumping job and show the many savings Pomona Pumps can make!**

JOSHUA HENDY IRON WORKS

Pomona Pump Co., Division • 50 Church Street, New York 7, N. Y.
Plants: 4301 So. Spring Ave., St. Louis 16, Mo.; 206 Commercial St., Pomona, Calif.



Close-up of the Pomona Pump at work on the *U.S.S. California*. Note below some of the features that make Pomona Pumps outstanding for ALL water-moving purposes...

CUT POWER COSTS

Pomona's semi-open impellers, easily adjustable at motor, vary the capacity of the pump according to requirement... and with proportionate savings in power. Eliminates wasteful throttling of flow!

SAVE SPACE

Pomona's modern vertical design puts the pump at water level where it needs no priming.. the motor at floor level where it occupies minimum space. Eliminates complicated piping and priming equipment!

TROUBLE-FREE OPERATION

Because all bearings below the motor head are fully lubricated by the fluid being pumped there is no risk of contaminating product or equipment with oil film. No oil tubes or grease chambers to maintain.

DELIVER MORE WATER

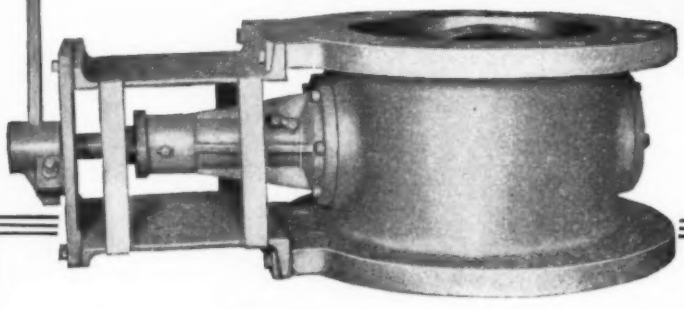
90%—and higher—pump efficiencies are not uncommon due to Pomona's Bulbous Vane End shape which smooths fluid flow—minimizes friction loss—increases pump efficiency!

POMONA
Water-Lubricated
PUMPS

Wide Range of Operation

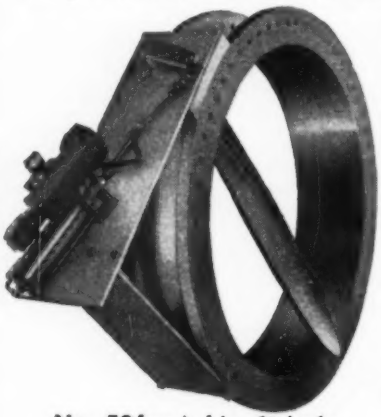
15 to 900 psi

No. 573
125-lb American Standard
—hand lever control with
extended stuffing box.



Consider the wide operating range of R-S Butterfly Valves. They are used for the reduction and regulation of pressure whether above or below atmosphere; to control liquid level; to relieve pressure and control back pressure; to maintain a constant differential pressure; to control rate of flow; to control combustion automatically as well as govern the output of pumps, fans, engines and turbines.

Coupled with these many uses and the inherent advantages of the R-S Butterfly Valve, are special metals for use where hard wear and severe stresses are encountered or where extreme temperatures and corrosive conditions exist. A further inducement to longer wear is the design of the valve itself. When the Butterfly vane approaches a closed position, the flow "fans out." There is no damaging "jet" effect to cause severe wear to the sidewall within a small area.



No. 586—A big 60-inch,
15-lb power-operated valve.

If your problem has to do with the control and shut-off of volume and pressure, and you are interested in simplified and less costly methods, write. Ask for R-S Catalog No. 14-B.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4536 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

famous inventor at Menlo Park, died at Schenectady, N. Y., on Sept. 9.

J F Clark, who represented the **Belmont Packing & Rubber Co** for over 30 years in the southern territory, died on Sept. 3rd.

Interchemical Corp announces its new address at Empire State Bldg, 350 Fifth Ave, New York City. **The Metallizing Co of America,** whose general offices are in Chicago, announces that eastern headquarters for sales and service are now in their new building, 135 Cedar St, New York City. V A Cook continues in charge of eastern operations.

APPOINTMENTS

Burrell S Manuel, Southern California district manager of **Westinghouse Electric Supply Co,** with headquarters at Los Angeles, was elected vice-president of the Supply Co. Born in Hannibal, Mo., his first electrical industry experience was with the Mountain Electric Co, Denver. After three years, he joined Westinghouse, and continued in various capacities until 1938 when he became Southern Calif. district manager.

Westinghouse Electric & Mfg Co announces appointments of: **Thos I Phillips,** vice-president, as head of the Pittsburgh divisions. Mr Phillips started with Westinghouse in 1915 as a toolmaker. He was elected vice-president in 1941. **Gwilyn A Price** as vice-president of the company, Pittsburgh, Pa. His responsibilities will include settlement of war contracts. He was formerly president of the Peoples-Pittsburgh Trust Co.

John Easton joins **Whiting Corp** as director of development and standardization activities. He was graduated from University of Edinburg in mechanical engineering and served in the Royal Navy and Air Force during World War 1. Since 1930 he has been with Civil Aeronautics Adm, recently as chief of the technical development division.

John C Seiler has been elected vice president of **Tube Turns,** Louisville, Ky. He will retain his duties as sales manager. . . . **C N Guerasimoff,** formerly assistant chief engineer, has been appointed chief engineer, engine division of the **Buda Co.** During his nine years with the company he has served as mathematician, engineer on stress

What's Behind the Trade Mark?

QUALITY

TRADE MARK

YOUNGSTOWN

SERVICE

Strength for a National Emergency

IN the period of World War I, The Youngstown Sheet and Tube Company "came of age."

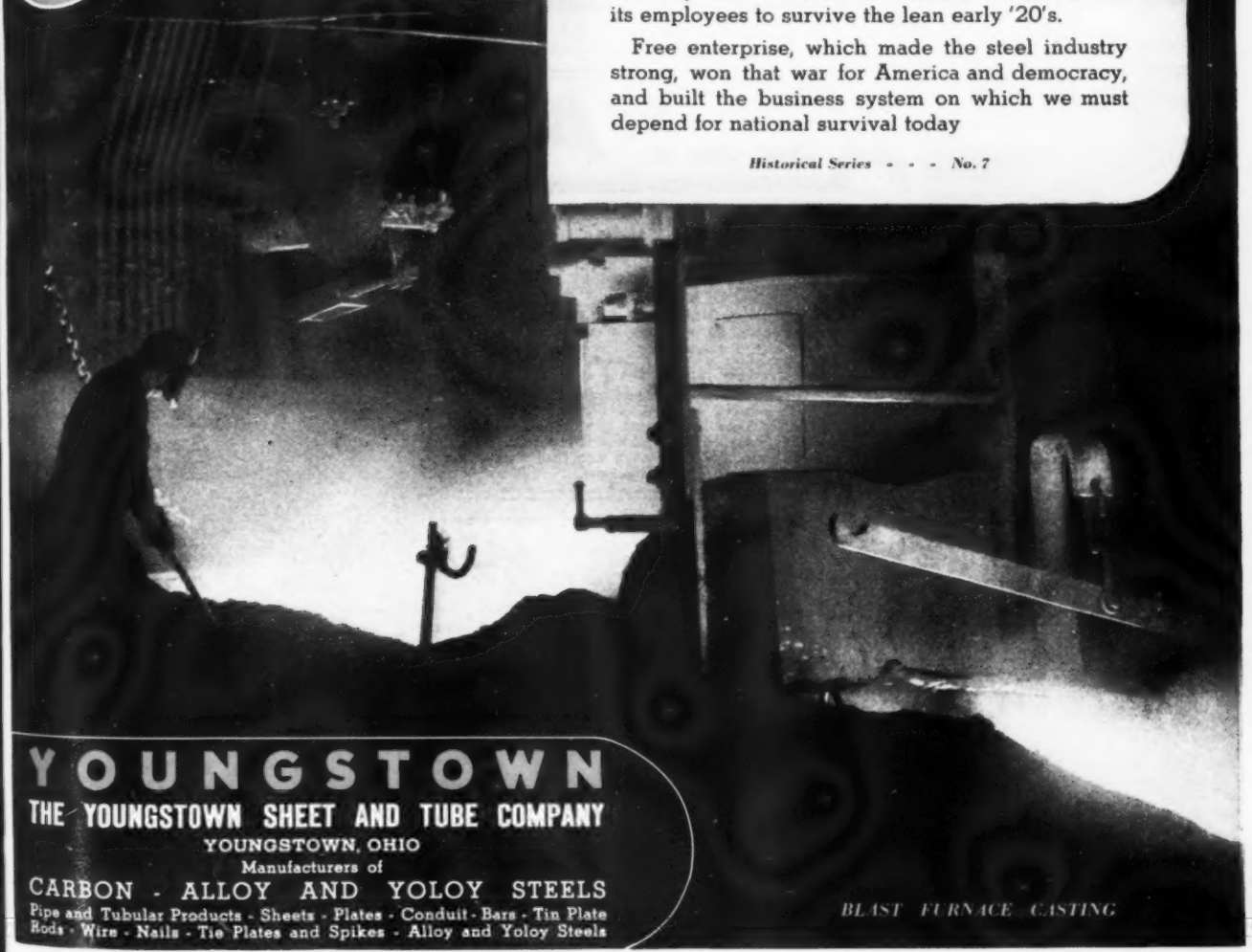
1915 began in depression--with fear and uncertainty at home and abroad. But that courage and vision which built Youngstown into a $20,000,000 corporation in 15 years, now brought a 50% increase in capital stock and a huge construction program. The next three years saw a modern, integrated plant completed--3 new open hearths, another blast furnace, batteries of coke ovens, additional finishing mills, new laboratory, hospital, works office building, hundreds of homes for employees. When war ended, nearly $39,000,000 of stockholders' money had been plowed into plant and facilities.

The decision to expand was timely. French and British orders came with a rush in mid-1916. After April 1917, America and her Allies demanded and received every possible pound of steel to win the war.

In those events we see a familiar pattern--tremendously increased production, labor scarcity, high wages, taxes taking 80% of profits. But fortunately the American system of private enterprise was enabling Youngstown to earn good profits--sufficiently high to pay off all its bonded indebtedness, to pay generous dividends to stockholders and to fortify itself with reserves which enabled it and its employees to survive the lean early '20's.

Free enterprise, which made the steel industry strong, won that war for America and democracy, and built the business system on which we must depend for national survival today

Historical Series - - - No. 7



BLAST FURNACE CASTING

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

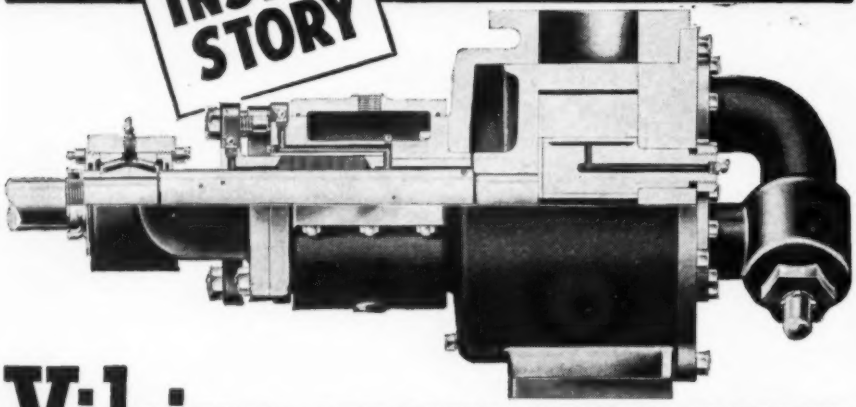
Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate

Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

The INSIDE STORY Of The Rugged



Viking HEAVY DUTY PUMP

The sturdy yet simple construction of the Viking Heavy-Duty Pump is graphically shown in the cutaway view above. It illustrates clearly the inside story of this unit—designed and built for long hard service.

You will note there are no small, intricate parts to wear and get out of adjustment. The pumping members are the standard Viking "gear within a gear," with only two moving parts. Available in sizes of 200, 300, 450, 750 and 1050 GPM.

Write today for free copy of Bulletin 2900. It will give you the complete story of Viking Heavy-Duty Pumps, including specifications and complete data on operation, lubrication and maintenance.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

ALLPAX

THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

THE ALLPAX CO., INC.
Mamaroneck, N. Y.
•
Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

LADISH

Quality (L) Fittings

TO MARK PROGRESS

ARMY (E) NAVY

FITTINGS DIVISION

LADISH DROP FORGE CO.
CUDAHY [MILWAUKEE SUBURB] WISCONSIN

analysis, and design engineer on gasoline and diesel engines. . . . **Worthington Pump & Machinery Corp** announces that **L E Hammer** has joined the organization as assistant works manager of its Moore steam turbine division, Wellsville, N. Y. A graduate of the University of Pittsburgh, his experience has been chiefly in the field of steam turbine manufacture.

Lowell E White, formerly test pilot for Wright Aeronautical Corp, has joined the research engineering staff of the **C-O-Two Fire Equipment Co,** Newark, N. J.

Strong, Carlisle & Hammond Co announces two appointments: **R L Clark,** manager of steam specialties dept. He has been with the company nearly 25 years. **L H Boleky** will represent the company's strong steam specialties in eastern Pa. and W. Va.

E Perry Holder has been elected president of **Wickwire Spencer Steel Co.** A graduate of Yale, Mr Perry served in World War 1. Practically all of his business career has been in executive positions connected with manufacture and sale of steel and other metal products. He resigns as president, Vulcan Iron Works, to take his new position. Wickwire Spencer also appoints **T H McSheehy** as sales manager, wire rope division.

Thomas R Coffey has been appointed manager of sales of the Wisconsin-Minnesota district by **Globe Steel Tubes Co,** with headquarters at Milwaukee. **Gavin S Younkin,** who has been liaison engineer for Brown Instrument division, **Minneapolis-Honeywell Regulator Co,** with its customers in the petroleum and chemical industry on the West Coast, has taken on additional duties as manager of the Los Angeles district office of the San Francisco branch.

The Edward Valve & Mfg Co, Inc, announce the appointment of the Dunbar Engineering Co, New York City, as sales representative for Connecticut, and the appointment of W E Bowler, Philadelphia, as sales representative for the Reading, Pa., territory.

Cutler-Hammer, Inc, announces the appointment of **P S Jones** as general sales manager. Mr Jones became associated with the company as a sales engineer in 1915.

General Electric Co announces that **E H Howell,** manager of the Toledo

SHAW PRE-FABRICATED PIPING INSTALLATIONS. . .

Save man hours

MAN HOURS are one of today's most precious commodities. Help save them in your operation, by specifying Shaw Prefabricated Piping and Installation. . . . When drawing up your plans — call on Shaw for advice on your piping requirements. It will save you man hours and money. Because: Shaw Piping is delivered to the job with all difficult prefabricating finished — installation by our trained workmen is quickly and efficiently carried out. . . . In the Prefabricated Piping and Installation field, Shaw stands for dependability. You can benefit by using our knowledge, based on our 50 years of operation.

J. Frederick Merz
Sales Manager

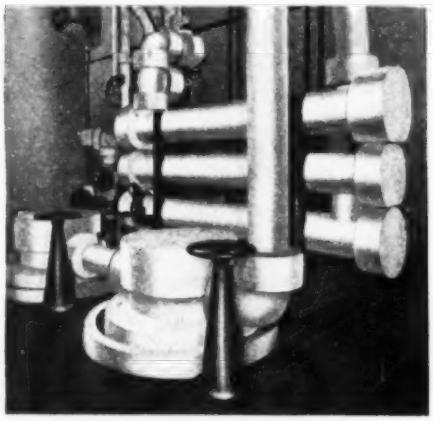
BENJAMIN F.
SHAW
COMPANY
2nd & Lombard Streets
Wilmington 99, Delaware

50th Anniversary Year

HENSZEY CONTINUOUS BLOWDOWN

is SAVING EQUIPMENT, MANPOWER and FUEL in HUNDREDS of AMERICA'S POWER PLANTS

- Saving EQUIPMENT: The Henszey Blowdown System prevents priming, foaming and carryover . . . and also prevents the formation of scale by simple chemical treatment of the feed water. Boilers last longer and tube burns are kept at a minimum. The resultant clean steam makes packings last longer—reduces wear on rods and cylinders—reduces turbine blade erosion—prevents sticking of reducing valves, traps, etc.—prevents superheater burnouts.
- Saving MANPOWER: The Henszey System is completely automatic. Boiler shutdowns and repairs are reduced to a minimum. No man hours lost unnecessarily replacing packings, repairing or replacing rods and cylinder rings, turbine nozzles, turbine blades, valves and other equipment along the line.
- Saving FUEL: The Henszey System offers complete, automatic blowdown without heat loss—a big fuel saving in itself. Then, too, boilers free from scale and sludge are more efficient—they require less fuel to produce the power load.



Plan NOW for LOW COST POWER.
Send for our folder "Complete Automatic Control of Boiler Concentration."

HENSZEY COMPANY
Dept. D 11 Watertown, Wis.

HENSZEY

CONTINUOUS BLOWDOWN

Flow Indicators • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

office for the past 13 years, has been made manager of the company's meter and instrument division. Simultaneously, S J Tombaugh, Cleveland, was named manager of the Toledo office, succeeding Mr Howell. **W F Rauber** has been appointed sales manager of the outdoor and station equipment section.

Lester D Chirgwin, general manager of **Farrel-Birmingham Co.'s** Buffalo plant, has been elected a director of the company. He started with the company in 1909 as office boy. After being graduated from Yale in mechanical engineering he returned as draftsman. He joined the U. S. Shipping Board in 1918, but returned to Farrel-Birmingham in 1919, first in the engineering and then in the sales department.

Adolph G Schroeder has been appointed manager of the machinery department, **Iron & Steel Products, Inc.**

Dr Rudolph G Minarik, chief designer and consultant on mechanical design for Kimberly-Clark Corp, has been appointed **Professor of Mechanical Engineering** in the College of Applied Science, Syracuse University.

Kenneth F Cramer has been appointed district manager of the New York Office of **The Baldwin Locomotive Works.** He will direct New York district sales for all divisions of the company.

Walter A Buchanan, manager of the Welch, W. Va. district of the Appalachian Electric Power Co. for a number of years, has resigned and accepted a position with the **Island Creek coal interests** in Huntington.

American Locomotive Co announces **Lawrence B Jackson** as director of engineering, diesel division. **Heman Greenwood** has been elected vice-president, **Carrier Corp** in charge of its international division. For the past six years he has been vice-president of U. S. Steel Export Co. **The C O Bartlett & Snow Co,** have appointed Martell & Ferree sales representative in the Philadelphia territory. **Cutler-Hammer, Inc.** have appointed **B M Horter** purchasing head of the company. **Lincoln Electric Co** announce the appointment of **William J Conley** as consulting engineer on mechanical and structural design utilizing welding and metallurgical problems involving welding processes. He was formerly chairman of the engineering dept of the University of Rochester. Appointment is announced of **T H Wickenden** as manager, development and research division, and of **H J French** as assistant manager by **International**

ENGINEERS AND MAINTENANCE MEN

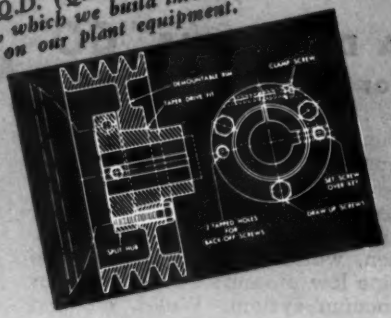
ELECT

QUICK DETACHABLE

SHEAVE

TO SOLVE THEIR DRIVE PROBLEMS

CHIEF ENGINEER *We have standardized on the Q.D. (Quick Detachable) Sheave Design, which we build into our products and use on our plant equipment.*



BALANCED DESIGN

- ✓ Overhang stresses reduced 25%.
- ✓ All weave and wobble eliminated.
- ✓ Reduction of bearing loads and shift stresses on short stub—shaft applications.

MAINTENANCE ENGINEER

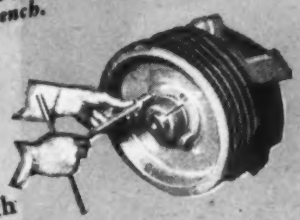
Seasonal speed changes are easy now—don't have to worry about alignment, scored shafts, burned bearings, or cracked sheaves, when we change Q.D. Sheaves.

ALWAYS TIGHT ON THE SHAFT

- ✓ The equivalent of a press fit.
- ✓ Perfect fit on undersize or oversize shafts.
- ✓ Capacity to handle any shock loads.

MAINTENANCE FOREMAN

The Q.D. Sheave is so easy to get on or off that the women in our shop do the job in short order with only a wrench.



EASY TO GET ON EASY TO GET OFF

- ✓ On or off with only a wrench in sixty seconds.
- ✓ Seasonal speed changes made faster, safer, easier, cheaper.
- ✓ Alignment always maintained...hub element remains intact on shaft.

One demonstration of the Q.D. (Quick Detachable) Sheave principle will convince you of its superior operating and maintenance advantages. For your demonstration write the nearest district office or call the Authorized Worthington Multi-V-Drive Dealer in your territory today. He is prepared to serve your transmission needs with a complete range of Q.D. Sheave sizes that will accommodate 10,000 drive combinations up to 150 horsepower, available from stock.

For more information write to the Standard Products Division for your copy of the New Q.D. Sheave Bulletin V-1400 B7C.

WORTHINGTON MULTI-V-DRIVES

COMPLETE DRIVES • SHEAVES OR BELTS ONLY

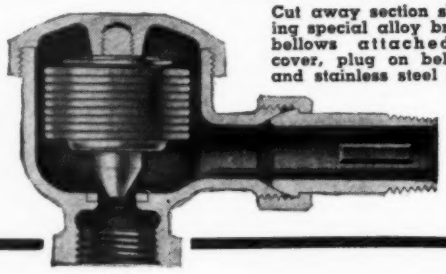
WORTHINGTON PUMP & MACHINERY CORPORATION

GENERAL OFFICES: HARRISON, N. J.

MULTIPLE V-BELT DRIVE ASS'N

MV3-11

The CRYER Thermostatic RADIATOR TRAP



Cut away section showing special alloy bronze bellows attached to cover, plug on bellows and stainless steel seat.

A DEPENDABLE "GO" for water and air AND A SURE "STOP" FOR STEAM

Simple, efficient and continuous, trouble-free, operation over long periods of service can be definitely depended on. The CRYER will function uniformly without attention, waste or noise on any two pipe low pressure steam, vapor or vacuum system. Water, air and gases are permitted to pass from radiator to return line while steam is prevented from doing so.

Designed for a maximum pressure of 30 lbs. the CRYER conforms in dimensions to the standards adopted by the Heating & Piping Contractors' National Association. Made in ½" and ¾" sizes; ratings 300 and 400 ft. radiation. Complete details available on request.

Also: CRYER INVERTED BUCKET Steam Traps in capacities from 500 to 38,000 lbs.; all sizes and repair parts for the J-M Ball Steam Trap.

CRYER TRAP AND VALVE CO. INC.
Manufacturers of steam specialties for more than 40 years.
366 MADISON AVE. NEW YORK, N. Y.

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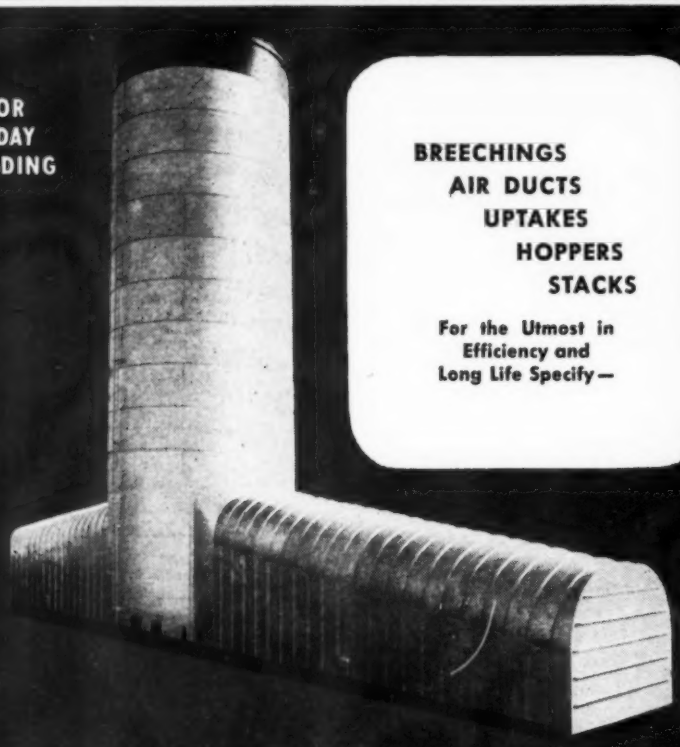
BREECHINGS
AIR DUCTS
UPTAKES
HOPPERS
STACKS

For the Utmost in Efficiency and Long Life Specify—



CONNERY EXPANSION STIFFENED CONSTRUCTION

CONNERY CONSTRUCTION CO.
SECOND & LUZERNE STS. PHILADELPHIA

Nickel Co. John W Clark, acting manager, Stamford division, **Conn. Power Co,** is now manager, succeeding Prentice M Hatch. Mr Clark has also been made chairman of Stamford divisional committee.

B F Goodrich Co announces four appointments: **Clyde O DeLong,** manager of operations, industrial products sales division, since 1941, has been named manager of B F Goodrich and Miller drug sundries sales. **George J Fisher,** formerly assistant operating manager, succeeds Mr DeLong as operating manager of the division. **Wm E Powell** is named field sales manager of B F Goodrich and Miller drug sundries and **Chas J Astrup** has been appointed assistant to Mr DeLong.

The Detroit Edison Co announces these appointments: **Paul W Thompson** has been elected vice-president with general responsibility for engineering and in charge of power generation, central heating and the construction bureau. **Angus D McLay** has been elected vice-president in charge of the sales dept and will continue as sales manager. **Samuel M Dean** has been appointed chief engineer of the system. All three men have held executive positions with the company for many years.

CONFERENCES

Industrial Hygiene Foundation's eighth annual meeting will be held at Mellon Institute, Pittsburgh, Nov 10 and 11.

The 50th annual meeting of the **American Society of Heating and Ventilating Engineers** will be held at Hotel Pennsylvania, New York City, Jan. 31, Feb. 1 and 2, 1944. Technical papers of basic importance will be presented. Organization of Committee on Arrangements is announced by Alfred J Offner, general chairman.

Fourth Annual Water Conference, Engineers' Society of Western Pa., will be held at Hotel William Penn, Pittsburgh, Pa., Nov. 1 and 2. Some of the papers on the tentative program are: (1) "New Methods of Testing Oxygen in Boiler Feedwaters in the Presence of Nitrites," by Harold Staley, Cochrane Corp; (2) "The Treatment of Cooling Waters," by L Drew Betz, W H & L D Betz Co; (3) "Experimental Studies of Boiler Scale," by J A Holmes, National Aluminate Corp; (4) "Latest Developments in Removal of Cations and Anions from Water by Demineralizing," by H L Tiger, Permutit Co.

It Takes *Experience* To Make Them Tick!

Whether it's putting together the numerous intricate parts of a clock . . . or assembling the many different, complex kinds of conveying equipment that makes up an efficient material handling system . . . experience is indispensable. This is a qualification you will find in abundance at Stephens-Adamson, a leading designer and manufacturer of handling equipment for over 41 years.

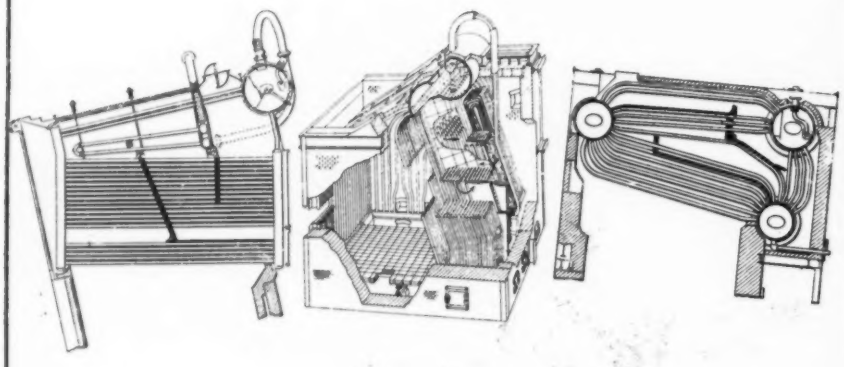
That's why it will be decidedly worth your while to discuss present or post-war conveying methods with an S-A engineer. Make a date now for such a discussion—either as a step toward putting present handling operations on a more efficient basis, or getting a head start toward the solution of new problems connected with peace-time production.

STEPHENS-ADAMSON MFG. CO., 5 Ridgeway Avenue, Aurora, Illinois

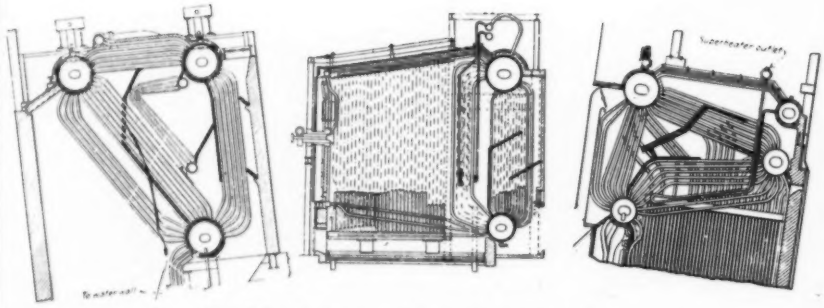
STEPHENS-ADAMSON MFG. CO.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



THERE'S A WILSON TUBE CLEANER FOR EVERY TYPE BOILER



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THOMAS C. WILSON, Inc.

PIPE AND TUBE CLEANERS EXCLUSIVELY

THE WILSON BUILDING

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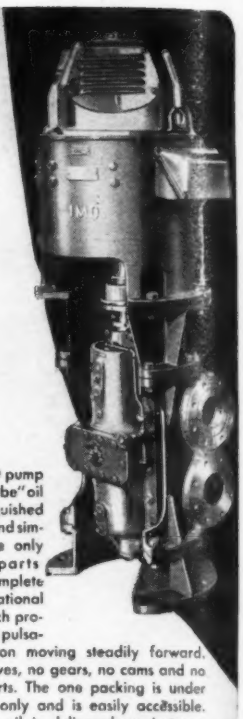
The **MOST PUMP** *in least Weight & Space*



IMO — I MOVE OIL

The De Laval-IMO pump for fuel oil and "lube" oil services is distinguished by compactness and simplicity. There are only three working parts which are in complete hydraulic and rotational balance and which propel the oil without pulsation, like a piston moving steadily forward. There are no valves, no gears, no cams and no reciprocating parts. The one packing is under suction pressure only and is easily accessible. Any quantity of oil is delivered against any pressure.

Ask for Publication I-111

IMO PUMP DIVISION

of the De Laval Steam Turbine Company

Trenton, New Jersey

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. . . While Traffic Rolls

Here's a new, fast way to patch broken concrete without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole — tamp — and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

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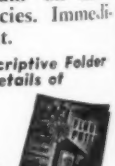

FLEXROCK Co.

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Write for Working Sample

Send for 36 page catalog.

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This UNIVERSAL packing—of long, pliable, anti-friction metallic alloy strands—assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F.—is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

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Ross Heater and Manufacturing Company, Inc. BCP Tube Bundle. Navy Type for Sea Water Service. Anaconda Cupro Nickel Tubes and Tube Sheets. Brass Baffles Tie Rods and Spacers.

In the construction of costly engineering equipment such as heat exchangers and condensers, nothing should be left to chance. Considering engineering time, labor and materials and the consequences of unsatisfactory performance, guesswork is much too costly.

That is why manufacturers of this type of equipment confer with the Engineers of our Technical Department when it comes to selecting condenser tubes. Not only have these Engineers devoted years to the metallurgy of tube alloys, but also to the study of the complex conditions under which condenser and heat exchanger tubes must serve —such factors as the character of the cooling water, turbulent flow, excessive velocities and entrained air. Their suggestions and vast fund of experience have helped many tube users obtain maximum value.

4398

A wide range of tube alloys for condenser and heat exchanger installations is available from The American Brass Company. They are fully described in Condenser Tube Publication B-2, which will be sent on request.

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from mine to consumer

Anaconda Condenser Tubes

THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Connecticut

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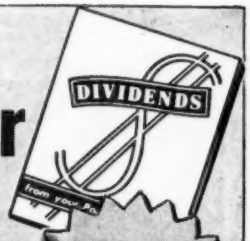
BUY ALL THE BONDS YOU CAN AFFORD . . . TURN IN ALL THE SCRAP YOU CAN FIND

FOR THE

Power Plant Engineer

WHO IS

Seeing Ahead



FREE

DO you have difficulty now in getting the management to take interest in power plant economies, better operation, etc.?

When this war is over, and the critical period of industrial warfare begins, you may have greater difficulty. For even in normal times, with money plentiful, you know how little of it goes into power plant improvement.

The reason? Often because the power plant engineer is an engineer—not a glib, smooth-talking *salesman*. He finds it hard to "sell" his plant's needs to his boss.

Now, more than ever before, he *should* be doing such selling.

Here is a new, free, 36-page book, "Dividends From Your Power Plant" prepared especially to help you sell yourself and your ideas to the management. It contains little that you, yourself do not already know, but much that the big boss may never have given thought to. Furthermore, it is written in simple, non-technical language that the boss will readily understand.

Not an advertising pamphlet, offers nothing for sale. Published solely as a service. It can help you plan your postwar future. Send today for your free copy.

FOR QUICK ACTION

Preferred Utilities Manufacturing Corp.,
1860 Broadway, New York 23, N. Y.

Please send me "Dividends From Your Power Plant"

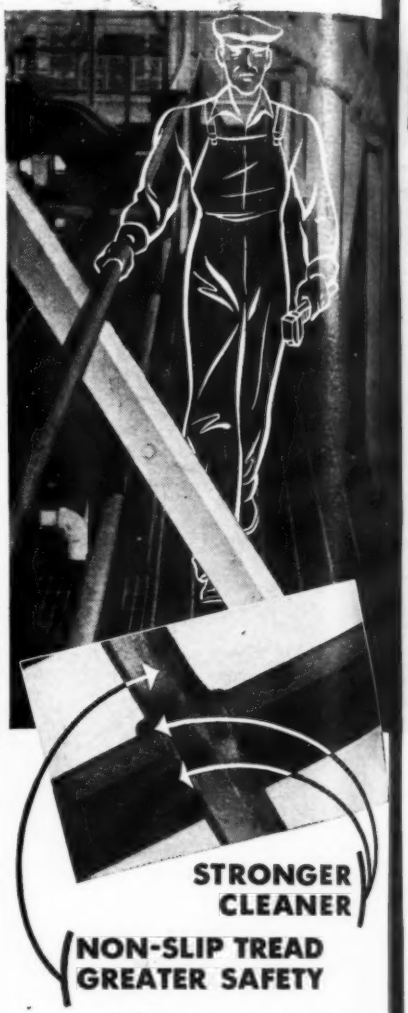
Name .....

Company .....

Address .....

P-11-43

PREFERRED UTILITIES



● That unretouched photograph of a small section of BATES • GRATES OPEN STEEL FLOORING gives you 3 important reasons for specifying BATES • GRATES for your open steel flooring.

Extra strength, cleanliness and safety are due to the low-temperature, pressure-welding of cold rolled steel HEX cross bars to main bars. These qualities are obtainable only by using this design and process and they cost nothing extra.

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Write for interesting, well-illustrated 8½" x 11" booklet that gives you all the facts.

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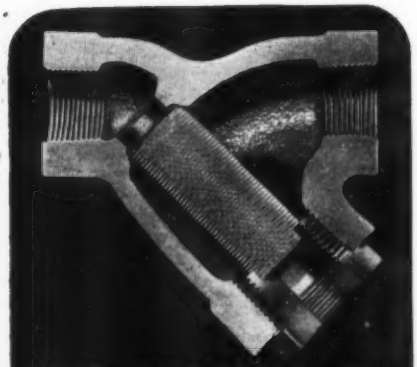
FLORI PIPING

THE FLORI PIPE COMPANY • ST. LOUIS — CHICAGO



We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion—*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200.

●

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PRECISION-built? Sure they are! Correctly designed? Yes, sir! Constructed from finest, carefully selected materials? Every part! But, this is what really is important to you: Every Lonergan gauge indicates pressures accurately on a clear, easy-reading dial...and retains its high initial accuracy even under violent pulsations! That's why Lonergan gauges are standard in many plants.

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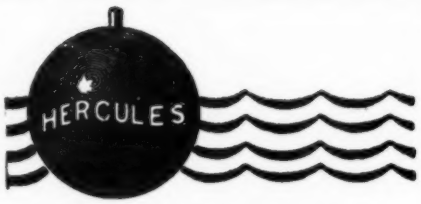

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Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

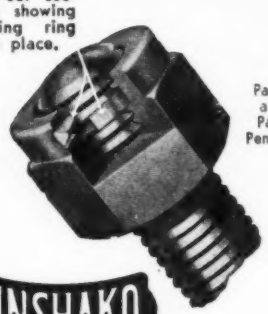
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

Won't work loose!

Cut-out section showing locking ring in place.



Pat'd. and Pat's. Pend'g.

UNSHAKO
Reg. U. S. Pat. Off.

SELF-LOCKING NUT

Play safe — use "UNSHAKO" Self-Locking Nuts.

A built-in, self-energizing locking ring which operates on brake band principle keeps the "Unshako" securely in place no matter how severe the vibration, yet it can be readily removed with a wrench and used over again as often as desired.

Write for details.

STANDARD PRESSED STEEL CO.
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OVER 40 YEARS IN BUSINESS

...if we'll do ours!

Our fighting men are giving 'em the works—and they'll keep it up until Victory is won. But they're depending on us to do *our* job on the home front. They are depending on us to work a full day *every* day . . . to conserve gas, oil, rubber, metal . . . to buy nothing except necessities and invest the balance of our incomes in War Bonds. They're doing their job—*let's get tough with ourselves* and do our job, too!

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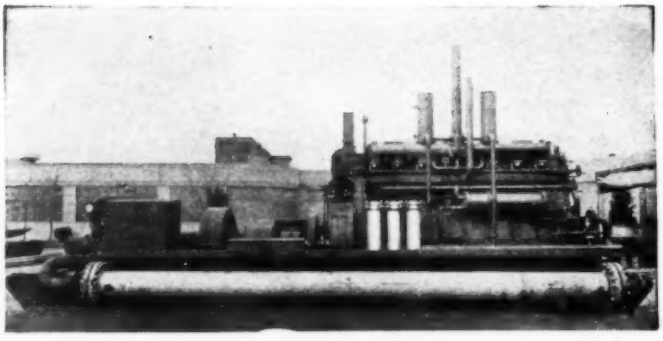

The key to better Diesel Engine Operation

The Absorbent Filter Recharge used in this Nugent Absorbent Depth Type Pressure Filter absorbs four times its own weight of water, dirt and impurities, yet it does not remove additives embodied in the oils. Fig. 1280A, No. 4L.

Clean oil, as secured through the use of Nugent Filters, can add hours of life to Diesel engines . . . reduce maintenance costs and help increase engine efficiency.

The above installation is typical of how Nugent Filters are helping today's industries. It shows one Nugent Absorbent Type Fuel Oil Filter and two Nugent Lubricating Oil Filters installed on a Cooper-Bessemer Diesel engine which is connected to a Worthington centrifugal pump. The installation is located at a well known pipe line station.

Nugent Absorbent Type Filters are available in a wide range of sizes for Diesel engines from 1 to several thousand H.P. in single containers. Write for details today.

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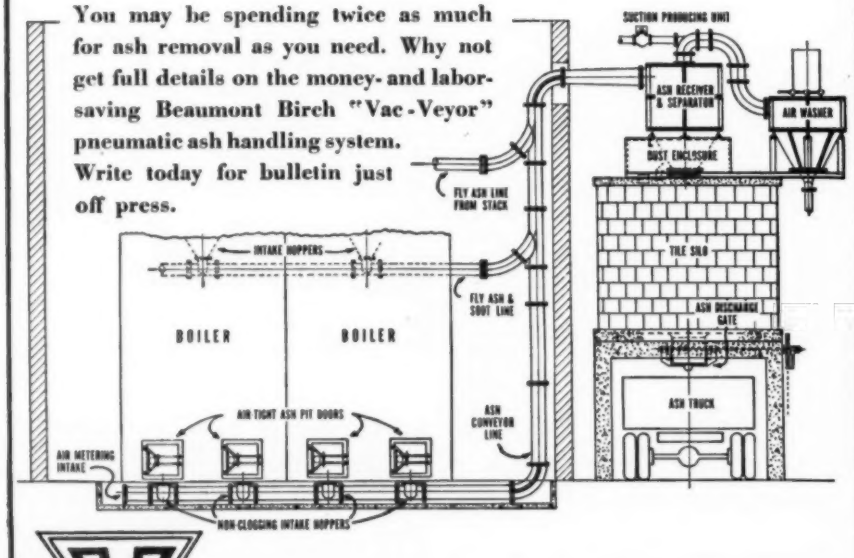
You may be spending twice as much for ash removal as you need. Why not get full details on the money- and labor-saving Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Write today for bulletin just off press.



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Make Your Overhead Valves SAFE And Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

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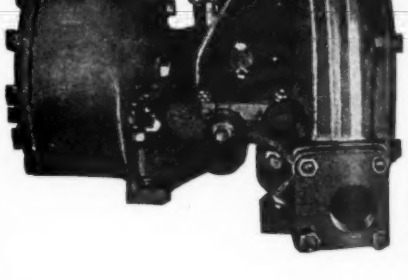
The COFFIN-Steam Turbine CENTRIFUGAL PUMPS

For Boiler Feed and general high pressure service.

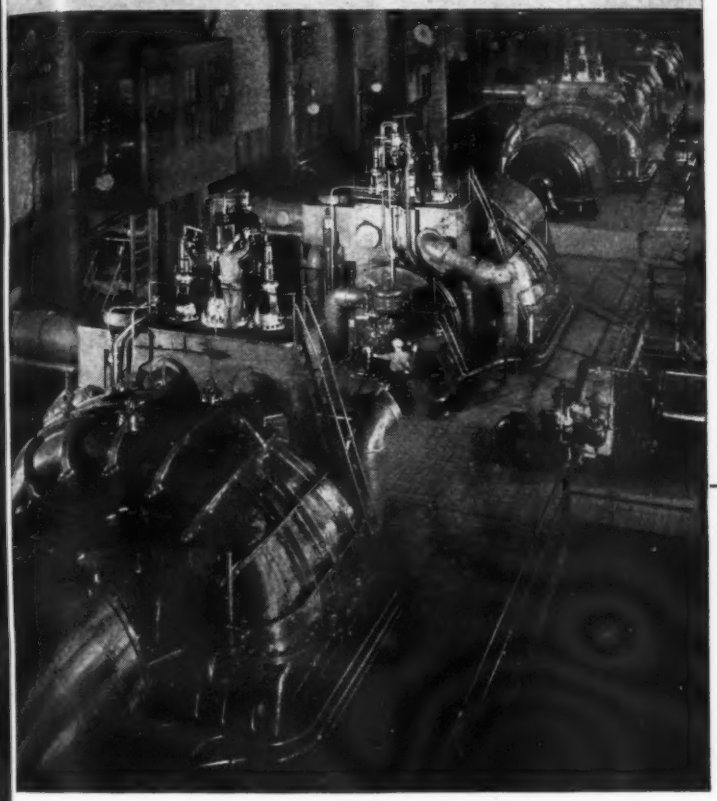
See previous issue for details



THE J. S. COFFIN, JR., Co.

ENGLEWOOD, N. J.

Gulfcrest Oil *is stripped for action*



against sludge and oxidation in your turbines —

Alchlor Process refining more effectively removes chemically active hydrocarbons and other impurities than other commercial methods

The performance records of Gulfcrest Oil in turbine systems of many of the leading power plants in the country are unmatched. Here's the important reason why:

Gulfcrest Oil is not only refined by conventional methods, but is super-refined by the Gulf Alchlor Process, the most thorough and effective method for creating the finest oils for turbine lubrication.

Developed 15 years ago, Gulfcrest Oil has become the leading turbine oil of the country.

Ask the Gulf Lubrication Service Engineer in your vicinity to give you the facts on the performance and characteristics of Gulfcrest—he will show you how they can be translated into important maintenance economies in your plant.

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FOR VICTORY —
BUY UNITED STATES WAR BONDS AND STAMPS

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Gulf Building, Pittsburgh, Pa.

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Let us tell you about

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★ How it protects against slag, flame and gas penetration, spalling, and premature furnace breakdown, and damage from excessive heat up to 3900° F.

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★ Why it is in successful use in so many of the foremost industrial and metallurgical plants; in the Army and Navy and Maritime Commission ships, Wherever America's furnaces are on the firing line.

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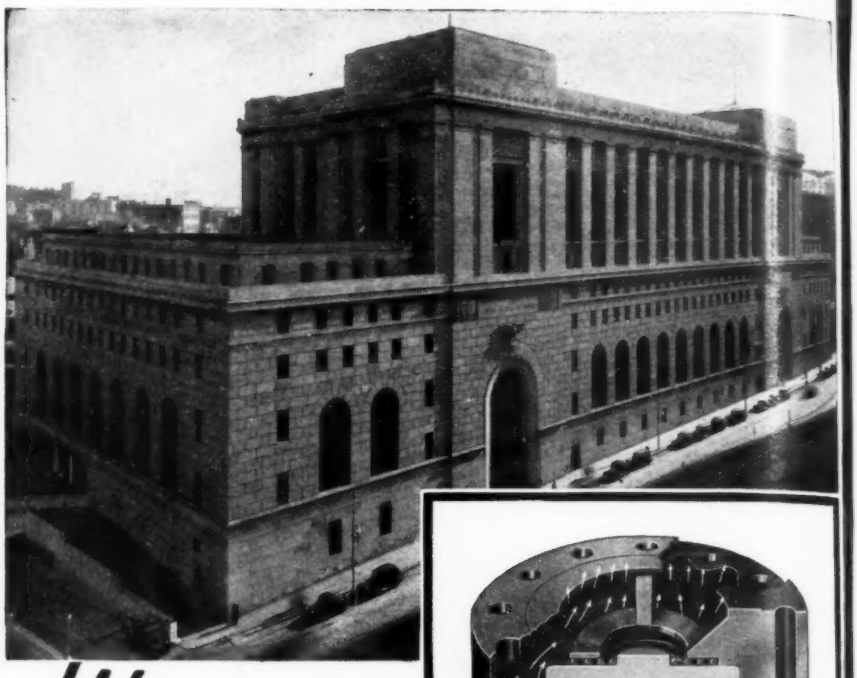

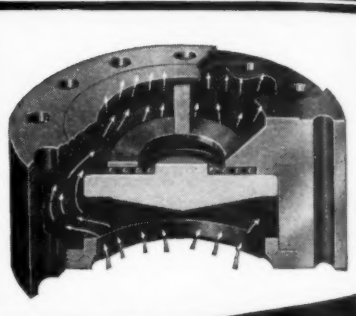

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Tennessee Valley Authority, Fontana, N.C.

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Radio City New York City

Kaiser Co., Inc., Fontana, Calif.

Standard Oil (Indiana) Whiting, Ind.

Tight under *every* condition of service and pressure—WILLIAMS-HAGER Flanged Silent Check Valves assure unrestricted and uninterrupted flow of liquids. No webs to hamper flow . . . operates in any position . . . and of simple, compact design.

Available in iron, semi-steel, bronze, cast steel, stainless steel or monel . . . 1″ to 20″ inclusive, pressure resistant to 6000 pounds.

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means providing the right treatment for correcting faults in water required for boiler feed, cooling or process. It is easier and cheaper to render water harmless by proper chemical treatment than it is to clean out scale by mechanical means or to replace critical power equipment. The world's finest water treatment laboratories are ready to work for you. Call a Nalco man today.

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the complete water treating service

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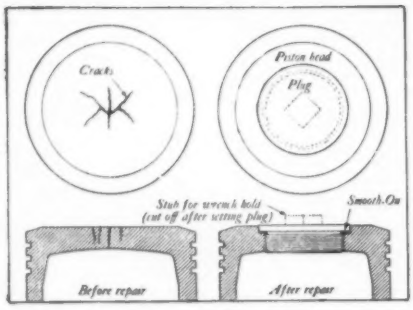
Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

A Low-Cost Repair That Saves Diesel Engine Piston Replacements



When the piston head of a Diesel or other internal combustion engine has been burnt or cracked from the extreme temperature, the Smooth-On repair shown above will restore the initial strength of the piston and effect a large saving over the cost of a new piston.

The repair consists merely of boring out the weakened head metal and threading the bored hole. A plug is cast and threaded to fit the hole. By coating the threads and flange of the plug with Smooth-On No. 3 before screwing into the hole, a tight, pressure-proof fit is assured, because the soft metal of the Smooth-On No. 3 flows into and fills all voids. Any cracks in the piston head which may extend outside of the bored hole are filled with Smooth-On No. 1 which will make a pressure-tight seal. The stub, by means of which the plug is screwed into place, is cut off after the plug is set.

Buy Smooth-On No. 3 in 1-lb., 5-lb. or 25-lb. containers from your supply house or if necessary, from us. For your protection, insist on Smooth-On—used by engineers since 1895.

SMOOTH-ON CEMENTS

STOPS LEAKS SMOOTH-ON No. 1 CEMENTS MORE

for the Motor Car and Boat, Home, Factory and Power Plant

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REPAIR HANDBOOK SHOWS HOW

40 Pages, 170 diagrams, and simple concise instructions for practical repairs to plant equipment, pipe lines and structures. A necessity in every plant. Your copy sent FREE if you fill in and return the coupon.

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Do it with SMOOTH-ON

Have You Tried FRANCE Metal Packing?

The France Representatives listed below are packing experts. They are experienced in the solution of engine, pump and compressor packing problems that have to do with pressure, temperature, friction and lubrication. They are good men to know well. Tear out this list or at least the number nearest you. Keep it handy. Use it to your advantage.

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Hercules Equip. 550 Third St. EXbrook 2575

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A. C. Elder, 2714 So. Hill St. PRospect 9529

NEW ORLEANS
R. M. Shad, 7738 Hampson St. WAL 4786

CHICAGO
J. H. McKenna, 1346 Washington Blvd. HAYmarket 6621

SEATTLE
W. H. Rober, 24 W. Connecticut St. ELlott 6644

MID-CONTINENT
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Request France Engineers to analyze your packing requirements.

THE FRANCE PACKING COMPANY
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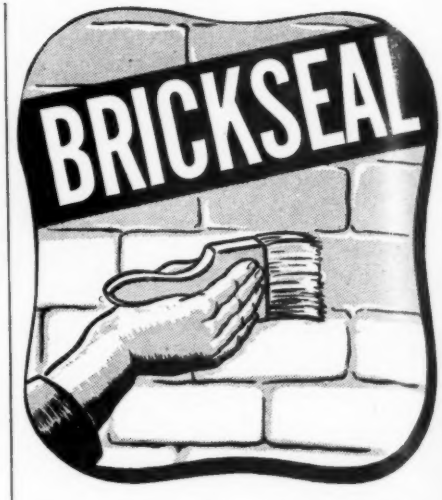
Original FRANCE METAL PACKING

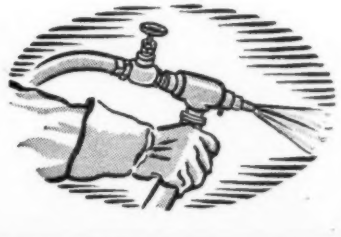


CRACK-PROOF Vitrified Armor for Your Furnace Lining

BRICKSEAL protects furnace refractories against destructive forces which cause cracking, spalling and disintegration. It can be brushed or sprayed on easily, and the boiler put into production immediately.

Brickseal is a combination of high fusion clays and metals combined in oils. Furnace heat vitrifies Brickseal permanently into all pores, cracks and joints, and binds the entire wall with a highly glazed, monolithic coating which prevents damage due to slagging, clinkering, corrosive vapors and flame abrasion. Brickseal cannot crack, peal or blister because it remains semi-plastic, and hardens when boiler cools.

Brickseal costs a fraction of a reline job. It reduces upkeep and shutdowns. Glazed surface reflects heat, increases boiler efficiency and steam production. Write for sample or representative, now.



BRICKSEAL REFRACTORY CO.

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An up-to-the-minute Gasket Chart showing the cross-sections of 36 most popular Gasket Types, their purposes and the characteristics which fit them for the specific services intended, is now available to interested engineers.

This chart has been issued as the third in a series of technical papers on Gaskets compiled by the Research Laboratory of the Goetze Gasket and Packing Company, Inc., oldest and largest manufacturers of industrial gaskets in America.

In requesting copies of this and succeeding issues of "The Gasket," write the company on your business letterhead, mentioning your position.

GOETZE GASKET & PACKING CO., Inc.
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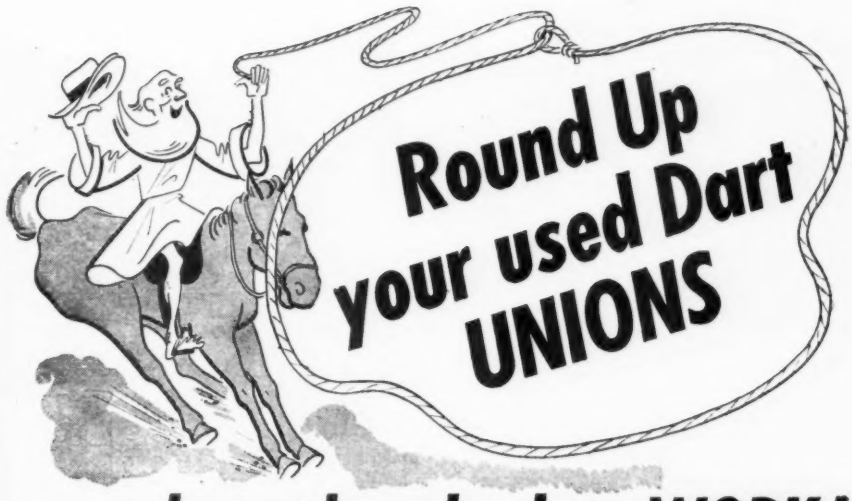
Goetze for GASKETS



...and put them back to WORK!

DON'T feel sorry for your used Dart Unions if they are "corralled" and put back to work. Dart Unions are *made* to be used over and over again—and give reliable, tight-joint performance each time, too.

Here are some reasons why Darts can "keep on going" after ordinary unions are forced to quit. Darts have matched bronze seats, ground to true-ball surfaces for correct, leak-proof seating . . . clean-cut threads that prevent scoring . . . extra heavy bodies and nuts made from High-Test Air Refined Malleable Iron that withstands rough handling.

If you *still* have any used Darts idling their time around your plant, head them for "the last round-up"—and get them back on the job. If you need *new* Darts, see your supplier today.

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E. M. DART MFG. CO., PROVIDENCE, R. I.

The Only 100% Mercury Switch Equipped Controls

MERCOID
AUTOMATIC ✱ CONTROLS

GIVE YOU:
The best in dependable performance

HAVE:
The longest control life

REQUIRE:
The least service attention

THAT IS WHY:
They are a favorite in essential war production plants

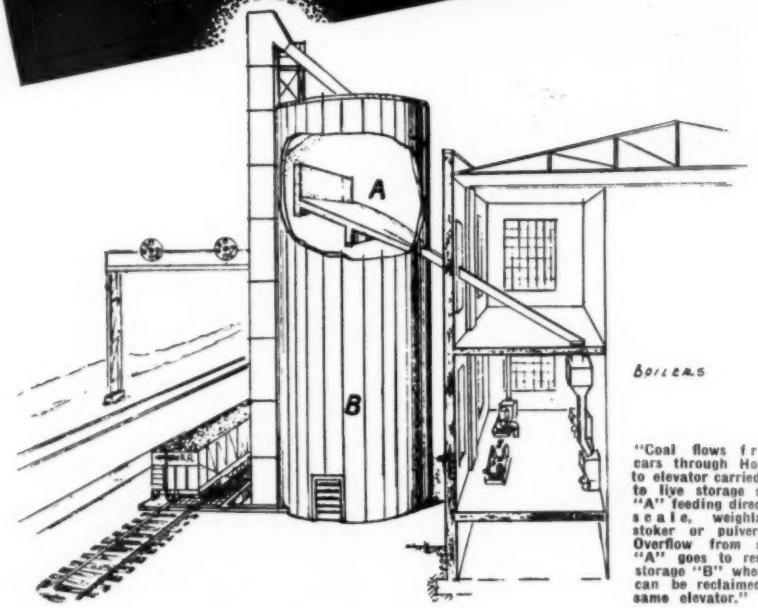
THEY REGULATE:
Electrically operated equipment in accordance with changes in temperature, pressure, vacuum, fluid level or mechanical movement

IF YOU:
Have a control or switch problem, let Mercoid engineers give you the benefit of their wide experience

Catalog No. 600 sent upon request

THE MERCOID CORPORATION
4225 BELMONT AVE., CHICAGO 41, ILL.

CONVERTING *from* OIL *to* COAL ?



"Coal flows from cars through Hopper to elevator carried up to five storage shelf "A" feeding direct to scale, weighlarry, stoker or pulverizer. Overflow from shelf "A" goes to reserve storage "B" where it can be reclaimed by same elevator."

We can offer Speedy Design
. . . QUICK CONSTRUCTION

Conversion jobs are "right down our alley" because they are fundamentally jobs involving the storage and handling of bulk materials with which we have had years of experience. And we've designed and constructed hundreds of coal-handling facilities for power plants.

Modern methods for handling coal results in clean, dustless boiler rooms. Coal can be made to flow much as a liquid. You need have "no aversion to conversion."

Our engineers and construction crews are fully qualified to study your boiler plant layout, to draw up detailed plans for converting from oil to coal and then to go ahead with a speedy, workmanlike job. Preliminary discussion of your conversion problem will entail no obligation.

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THE NICHOLSON CO.
CONSTRUCTION · CEMENT-OIL-CHEMICALS

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Handier stronger and *more powerful!*

The musket of 1776 was a clumsy thing, almost six feet long. And you had to "wait until you saw the whites of their eyes" before you could be sure of hitting anything with it. Compare it with our modern Garand — the finest infantry weapon in the world, far handier, capable of sustaining much greater breech pressure, and many times more powerful. It's the same with tube cleaners . . .

Packed with power, the new Elliott 1300 Series tube cleaner hits a new high in tube cleaner development. It will get around bends in which other cleaners would jam. It will clean thoroughly, because its short length permits of using a cleaner which fits the tube snugly, and will not feed through until the tube is completely cleared. Its new lubrication system floods all bearings with oil—front bearing as well as rear—thus enabling higher speed, and more power to the cutters, to say nothing of longer service and less maintenance. Used with the new Elliott FH coupling, and cutter head with the Elliott universal joint, here is a cleaner that will snake its way around hitherto uncleanable tube turns, cleaning faster and more thoroughly.

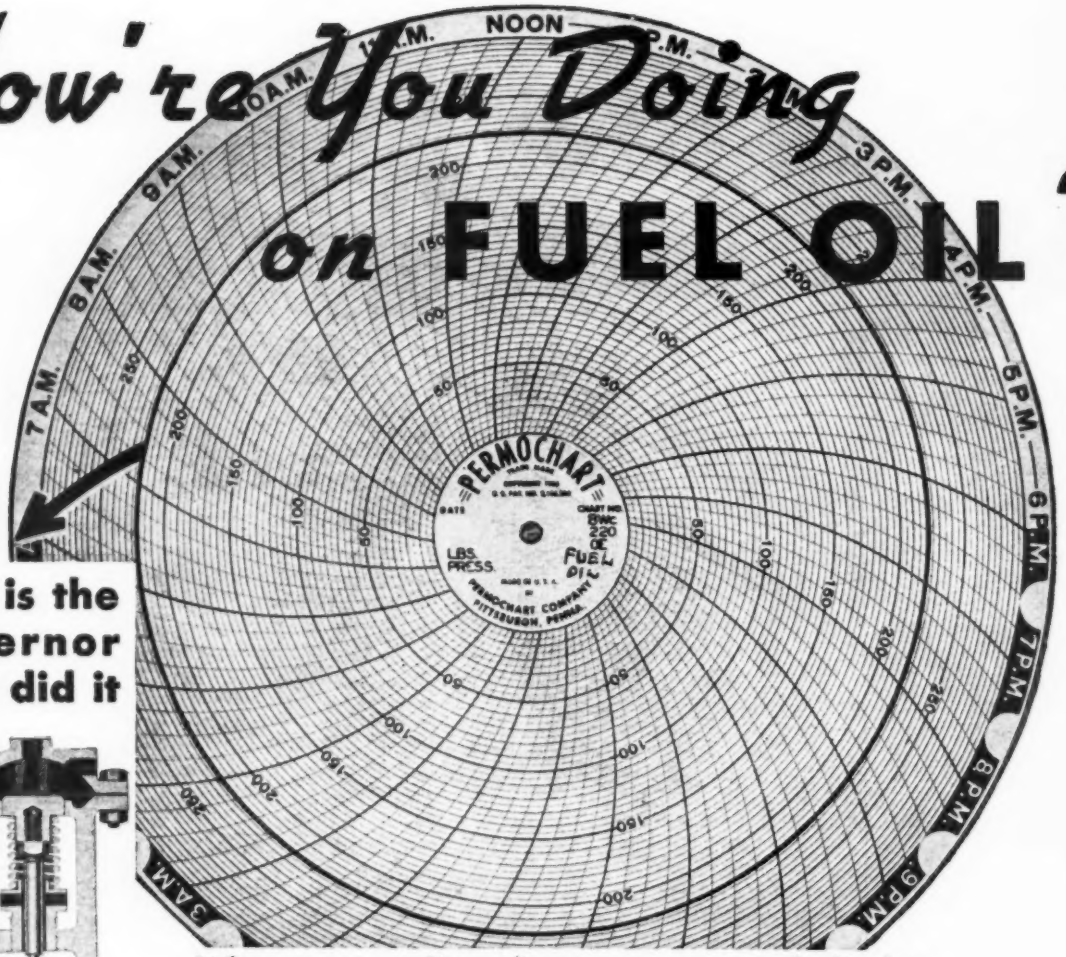
Every power plant engineer will want the detailed data. Write.

THE *New*
ELLIOTT
1300 Series
TUBE CLEANERS

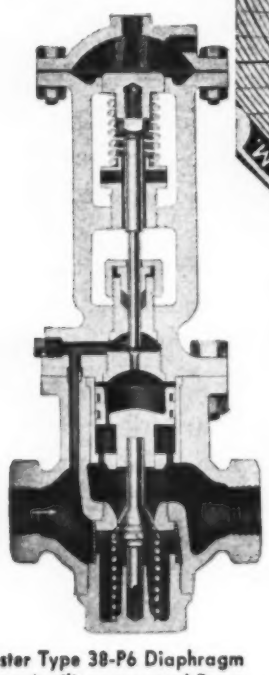
ELLIOTT COMPANY
Tube Cleaner Division
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Y-200

How're You Doing on FUEL OIL?



This is the governor that did it



Foster Type 38-P6 Diaphragm type, Auxiliary operated Pump Governor for constant pressure service. This type of governor operates on initial pressures up to 600 lbs. at 750°F, for discharge pressure up to 800 lbs. Full details on this and other governors in Catalog 70.

When you are making adjustments to squeeze the last b.t.u. out of your fuel oil allotment, you need constant fuel oil pressure to start with. And fuel oil pressure is one variable you can easily eliminate.

The chart shows a 24-hour cross section of the close regulation you can expect from a Foster Type 38-P6 Pump Governor, day in, day out—year after year.

This particular governor has been giving satisfactory, trouble-free regulation for 9 years because it is the right size and type for the job, and it was properly installed.

There is a Foster Automatic Valve for *every* service requirement. When you are faced with a pressure problem or temperature problem of any kind, why not select the proper size and type from a *complete* line where you are not limited in your choice? Our engineers will be glad to help you find the right answer to your problem.

Illustrated catalog of the complete Foster line, with many pages of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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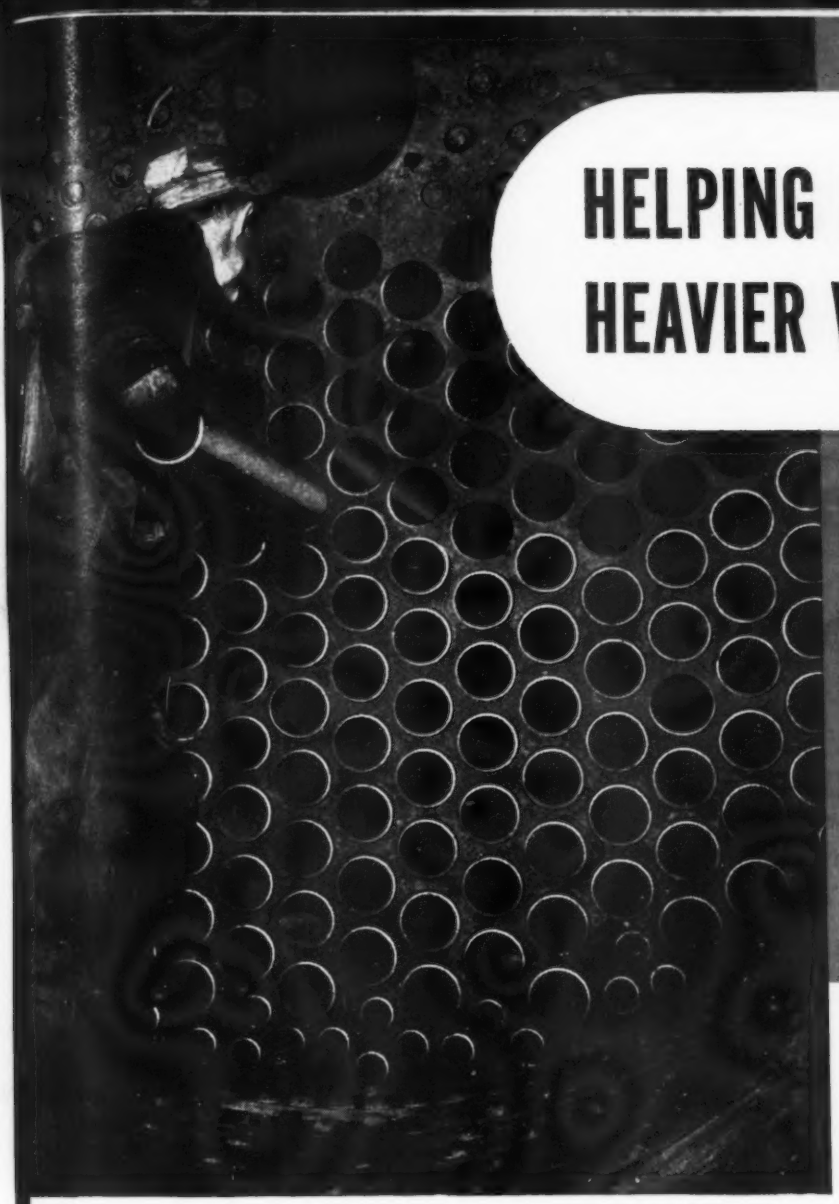


HELPING RAILROADS MOVE HEAVIER WARTIME LOADS..

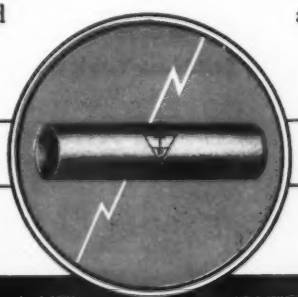
Talon's Electric Welded Steel Tubing . . . . .

SIZES FROM 5/8" O.D. TO 4" O.D. UP TO 40' IN LENGTH

This illustration shows Talon's Electric Welded Steel Tubing being used in boiler construction by the Lima Locomotive Works for the Central of Georgia Railway.

Talon's Electric Welded Steel Tubing has characteristics which are particularly well suited to locomotive boilers. It withstands the terrific high pressure and structural strain which locomotives are undergoing to haul heavier wartime loads more rapidly. Cold-formed from flat-rolled steel, Talon's tubing is concentric and uniformly accurate to size for easy installation. Proper normalizing provides maximum ductility for expanding and beading, and increases physical properties.

There are no thin, weak spots in the wall of Talon's Electric Welded Steel Tubing . . . accurate gauge of the steel determines uniform wall thickness. No extra metal is added in welding . . . grain structure of wall and weld is homogeneous. Hydrostatic testing of every foot of Talon's Pressure Tubing is your assurance that the weld and adjacent area are as strong as the wall. Sizes from 5/8" to 4" O.D. are available in lengths up to 40 feet.



PRESSURE **MECHANICAL**

TALON . . INC.

STEEL TUBE DIVISION **OIL CITY, PENNA.**

THIS IS THE **1st** of a series explaining why G-T PACKINGS give better service.

A SIMPLE Line of Packings

8 REASONS for the Superiority of G-T Packings

1. SIMPLE LINE . . . makes correct selection easy
2. COMPLETE LINE . . . an exactly suitable type for every service
3. SELF LUBRICATING . . . each individual strand saturated with lubricant
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7. EXPERIENCE . . . 80 years of manufacturing experience.
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There is no confusing multiplicity of style numbers in the G-T line of Packings. Eighty years of manufacturing experience have taught us that a few types are sufficient to provide an efficient packing for every need.

When you standardize on G-T Packings, you gain SIMPLICITY . . . of selection . . . of purchasing . . . of warehousing . . . of application.

Simplicity is but one of the many important advantages of PALMETTO and other G-T Packings. In the panel at the left are listed features that make these packings stay soft . . . protect rods, shafts and stems . . . improve the service of packed apparatus . . . reduce annual packing costs.

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PALMETTO *for steam, hot water, air.* PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT **PACKINGS**

G-T *self-lubricating* **PACKINGS**

CUT THE "BABY LIGHTNING" HAZARD

ARMSTRONG HUMIDIFICATION

GOOD NEWS FOR PLANTS that have fire hazard due to static electricity ("baby lightning"): you can get rid of this and also improve human working comfort by installing Armstrong Steam-Type HUMIDIFICATION.

You also end other dry-air evils due to winter heat, such as fiber breakage, paper shrinkage, warpage and checking of wood, etc. In offices, HUMIDIFICATION raises personal efficiency, cuts winter colds, improves paper handling.

Simple, practical, quiet, high-capacity; connected to steam lines like a unit heater. As low as $100 for 40,000 cu. ft. capacity. Used in hundreds of leading plants. Nothing like it on the market. Ask for literature.

Armstrong Machine Works
812 Maple St. Three Rivers, Mich.

WRITE FOR BULLETIN

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ARMSTRONG STEAM TYPE HUMIDIFIERS

WASTE IS SABOTAGE!

ARE YOU DOING ALL YOU CAN TO AVOID IT IN YOUR BOILER PLANT?

Fuel is a vital weapon of war. It is imperative that boiler plants fired with fuel oil, transfer every last heat unit to useful power or heat.

To make sure that your heat or power plant is delivering all the steam of which it is capable with the least possible fuel consumption . . . check your operation against the ten points listed opposite.

- ✓ **All mechanical parts of burners should be kept clean and in good operating condition. Worn parts should be promptly replaced. Keeping equipment in good condition will save you many times over the cost of replacements.**
- ✓ **Temperature of oil supplied to burners should be watched carefully. Bunker "C" or No. 6 oil should be supplied to burners at a viscosity of 150 SSU for best atomization.**
- ✓ **Atomizers should be properly adjusted for best position with relation to air register throat.**
- ✓ **No more air than is absolutely necessary for complete combustion of the fuel without objectionable smoke should ever be supplied to the burners. If at all possible a recording flue-gas analyzer should be installed. If a recording analyzer is not installed, frequent analysis of combustion gases should be made with a hand analyzer.**
- ✓ **The fire side and water side of boiler surfaces should be kept clean, as soot on the first and scale on the second will reduce boiler efficiency. A definite schedule for cleaning tubes should be established.**
- ✓ **Uptake gas temperature should be checked against boiler manufacturer's guarantees. Too high a temperature in the uptake is usually an indication of a dirty boiler.**
- ✓ **Boiler baffles should be maintained in good condition. Leakage through baffles will allow partial short-circuiting of the gases, which will also cause a high exit gas temperature.**
- ✓ **Boiler settings, tube doors, explosion doors and boiler entrance doors should be kept airtight. Infiltration of air through any of these parts causes a serious loss in efficiency.**
- ✓ **Test checks should be made frequently on the overall efficiency of the boiler plant.**
- ✓ **Auxiliary equipment such as feed water heaters, pumps, etc., should be maintained in the best possible condition.**

TODD SHIPYARDS CORPORATION

TODD COMBUSTION DIVISION

601 West 26th Street, New York 1, N. Y.

NEW YORK · MOBILE · NEW ORLEANS · GALVESTON
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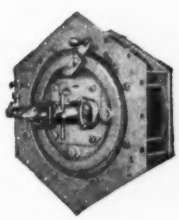


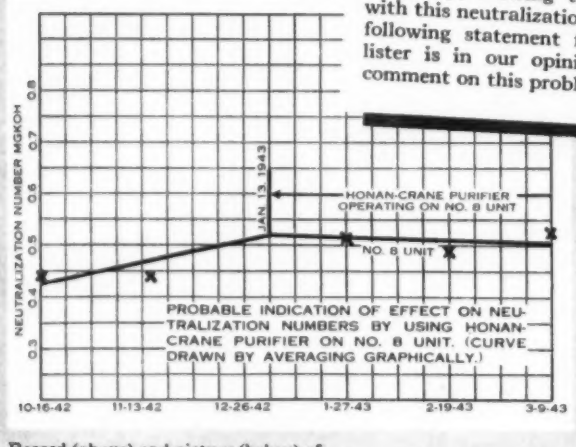
TODD BURNERS ★ ★ ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

HONAN-CRANE "Continuous" Oil Purifier gives positive control of Neutralization factor in turbine oils . . .

● There is considerable controversy over what is the proper neutralization factor in Turbine oil. However, *the control* of this factor is generally recognized as important in successful turbine operation.

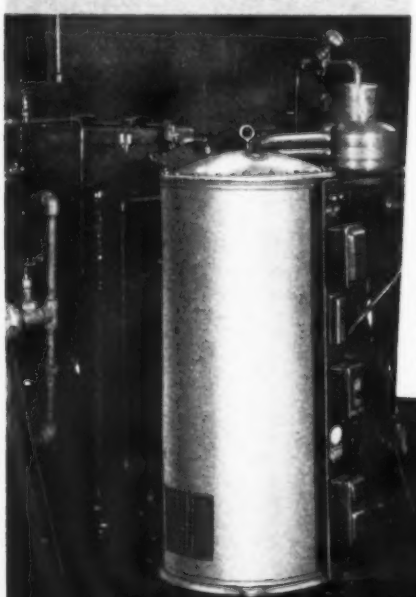
A Honan-Crane *"Continuous"* Oil Purifier in addition to keeping Turbine oil free from abrasives and dirt also gives you positive control over the acid or neutralization factor. The operation of the Purifier being Direct Connected can be regulated to maintain the neutralization number wherever desired.

● We recently received some data from John Collister, Production Engineer of the Ohio Public Service Company, showing their experience with this neutralization problem. The following statement from Mr. Collister is in our opinion a splendid comment on this problem. We quote:



Record (above) and picture (below) of Honan-Crane Purifier operating on a 30,000 K. W. Westinghouse Turbine at Ohio Public Service Co. at Warren, Ohio. Oil Reservoir 1,800 gallons.

"The tabulated data does not show spectacular changes and contains apparent contradictions. However, the test for acidity in oil is extremely delicate. The answer is in decimal parts of thousandths of grams or sub micrometer measurements. The most careful man could not test oil and be positive that the significant figures in results such as we have tabulated were absolutely correct. The tables do indicate trends and show that the Purifier holds acidity below 1.0 MgKOH mark that we use as an upper limit, even though the oil is worked hard."



HONAN-CRANE CORPORATION
Research Laboratories and General Offices
1200 SIXTH STREET LEBANON, INDIANA

accuracy two ways

REPLACE skill-wasting methods with quick precision while insuring accuracy of fit. Use Laminum shims to provide correct adjustment in both shop assembly and field service.

Shims cut to your specifications. Stock shim materials obtainable from your dealer. Write us for further information and shim application chart.

Laminated Shim Company
Incorporated
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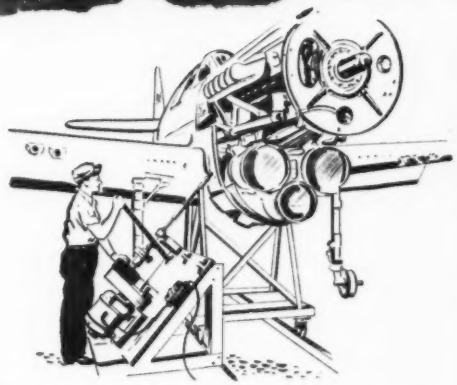
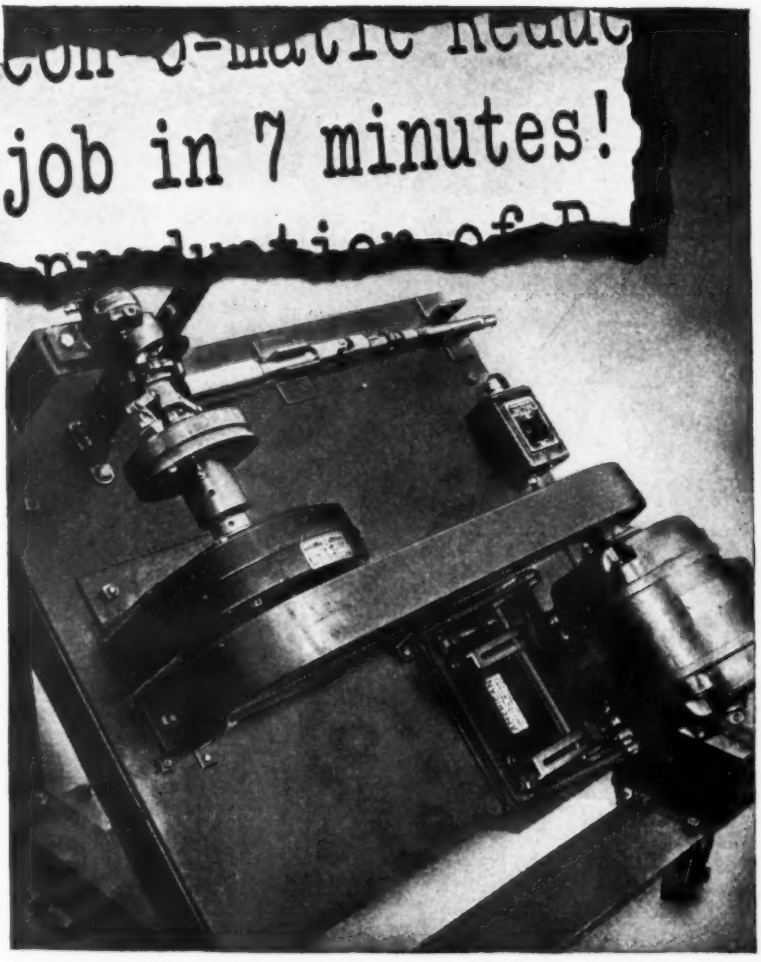
LAMINUM
THE SOLID SHIM THAT *peels* FOR ADJUSTMENT
2043

The American Econ-o-matic Reduc does a 2-hour job in 7 minutes!





The close tolerances of the P-40's Allison Engine makes pre-oiling necessary. The electric "mule" shown above does that job. Formerly, it was necessary to remove the plane's Inertia starter—replace it with an electric starter to slowly turn the motor—then put the Inertia starter back on. That used to take 2 hours.

Now—equipped with an American Econ-o-matic Reduction Drive—this pre-oiling "mule" does the job in 5 to 7 minutes! Switching Inertia and electric starters back and forth is eliminated, because the "mule" connects directly to Inertia starter and supplies the slow steady power needed.

That's how the *Versatility* of American Drives helps Curtiss-Wright speed up production of fighting P-40s!

This "mule" makes full use of American Drive advantages.

The Reduction Unit—with a standard 13-to-1 ratio—is compact, efficient, simple to install. The desired slow output speed is easily obtained by selecting proper sheave sizes.

The American Econ-o-matic Drive is used in conjunction with the Reduction Unit to match belt tension to each variation in the load. This eliminates belt slip, insures longer belt life and provides smooth, "cushioned" starting.

Such unusual applications prove the versatility and efficiency of American Drives. American Reduction Drives are available in six standard stock sizes that fit any job from 1/4 to 25 H.P. . . . *give you any speed you need from 11 to 154 R.P.M.* And American Econ-o-matic Drives—either short-center Flat-belt or V-belt—reduce belt and bearing wear, save R.P.M. lost by slippage and increase machine efficiency through *automatic belt tension control!*

Navy "E" for excellence awarded Feb. 12, 1942.

Send for Complete Handbooks

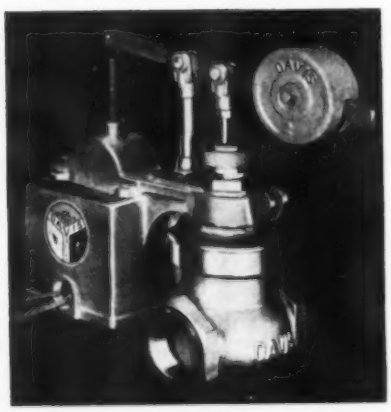
Here are two newly-revised, graphically illustrated handbooks that give typical installations—specific applications—drive selection tables—full instructions—all the data you need to select the right drives for your purpose. Write now for your Econ-o-matic and Reduction Drive handbooks.

The American Pulley Company
4226 WISSAHICKON AVE., PHILADELPHIA 29, PA.

DAVIS SOLENOID VALVES

For Use WHEREVER Electric Control Can Be of Advantage

WHERE an automatic distant controlled valve is the requirement, a Davis Solenoid Valve is the answer. Types range from single seated flow control valves to four way pilot valves and two-step throttled opening valves. They are available for steam, air, gas, water, oil and viscous liquids in sizes from 1½" to 12" and for pressures up to 1,500 lbs. Explosion proof solenoids and leak proof valves available where required.



Unit illustrated at left is No. 93, a typical single seated, pilot operated general purpose valve. ASK FOR BULLETIN S-1.

DAVIS REGULATOR COMPANY

2540 S. Washtenaw Ave. **Chicago, Illinois**

ADAMANT FIRE BRICK CEMENT

Keep Boiler "Absenteeism" to a Minimum

Keep your boilers on the job with longer-life linings laid up with Adamant Fire Brick Cement. Its exceptionally high bonding strength makes joints (usually the weakest part of the entire construction) as strong as the brick they bond.

TESTED and PROVED

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature; 1270 lbs. at 2600° F. Adamant has a P. C. E. of 3000° F. plus. For more details, write.

BOTFIELD REFRACTORIES COMPANY

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CONTROLLED FLOW TIGHT SHUT-OFF of Air - Gas - Steam

ROCKWELL Blast-Gate VALVES

Rockwell "Blast-Gates are built strong, light, dependable for quick movement, accurate, easily adjustable control of air, gas or steam and non-leaking air-tight closure at pressures to 15 p. s. i. Available in 1 to 48" pipe sizes, slide or butterfly types; with pull, lever, hand wheel, chain wheel or automatic control.

Slide Valve, lever type, also pull and wheel control; threaded or flanged connection.

Butterfly Valve, dial indicator hand wheel control; also lever, chain wheel and automatic control.

★ ★ ★

W. S. ROCKWELL CO.
Blast-Gate Valve Division
48 Church St., New York 7, N. Y.

THE FORMER WAY
Milling eccentric key seats in finished crankshafts required 11 hours on a $75,000 machine.
THE HENDY WAY
requires but 4 hours, on a relatively simple-to-operate $2500 tool.

Time Savings
THAT SPEED VICTORY

When the seven hours saved on this one operation are multiplied by over 400 engines, the total amounts to more than a year of eight-hour days gained in speeding production for victory. But important as this saving may be, it is only a part of the story... it is only *one of many* Hendy short-cuts which have been made by adapting streamlined, mass-production methods to the building of giant steam engines, steam turbines and marine reduction gears.

This saving of time is one of the main reasons the Iron Men of Hendy have been able to produce so huge a volume in so short a time. When victory is won and Hendy methods are directed toward the production of industrial machinery, they will guarantee similar savings.

JOSHUA HENDY IRON WORKS

ESTABLISHED 1856

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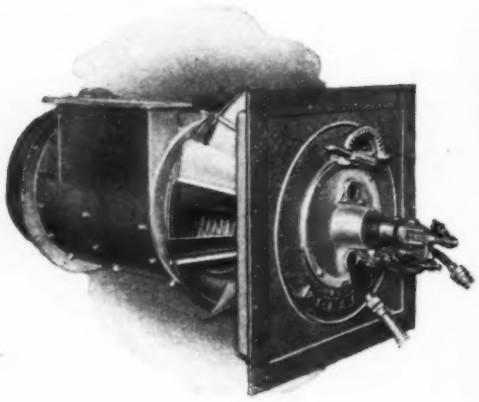
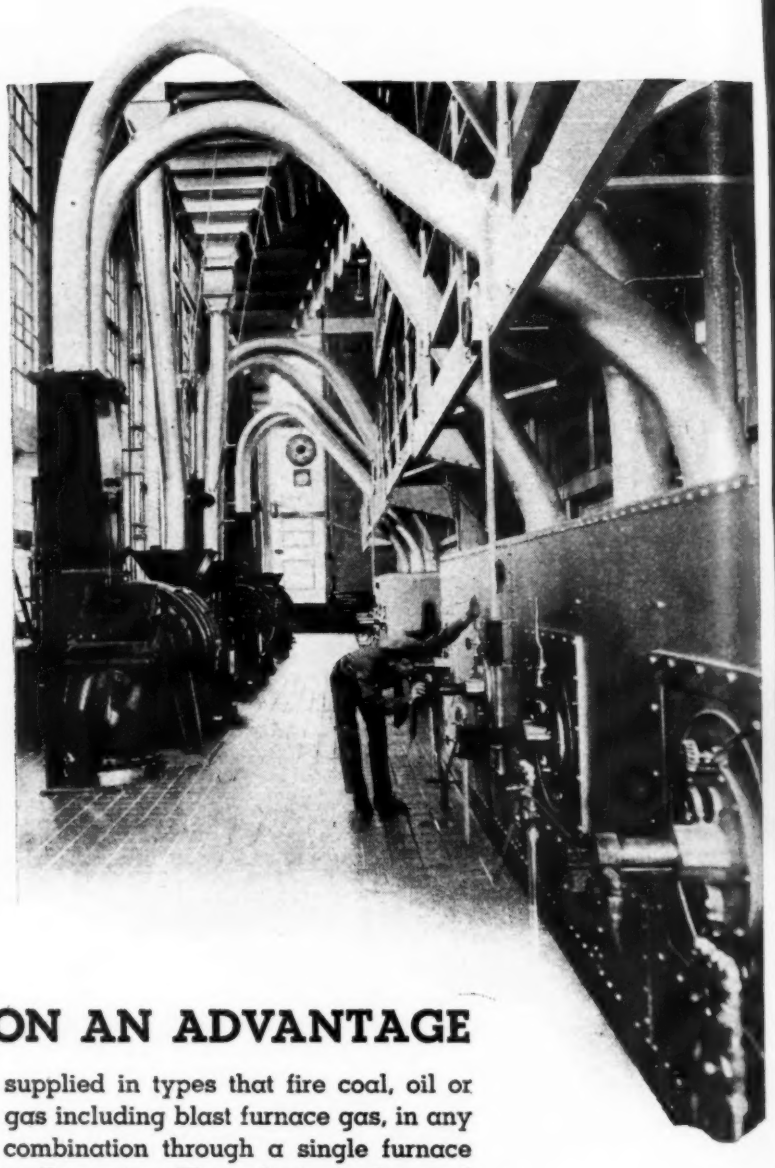
Divisions: POMONA PUMP COMPANY
CROCKER-WHEELER ELECTRIC MFG CO.

Manufacturing Plants: SUNNYVALE, LONG BEACH, POMONA and TORRANCE in CALIFORNIA • AMPERE, N. J. • ST. LOUIS, MO.
Branch Offices: NEW YORK • WASHINGTON • PHILADELPHIA PITTSBURGH•CHICAGO•ST. LOUIS•SAN FRANCISCO•LOS ANGELES

By the use of special jigs and fixtures that automatically assure precision alignment, the time required to assemble Hendy crankshafts has been reduced from 112 hours to less than 4—an increase in production speed of 2800%.

Combined Pulverized Coal and Wide Range Oil Burner.





Install the PEABODY COAL BURNER *and*

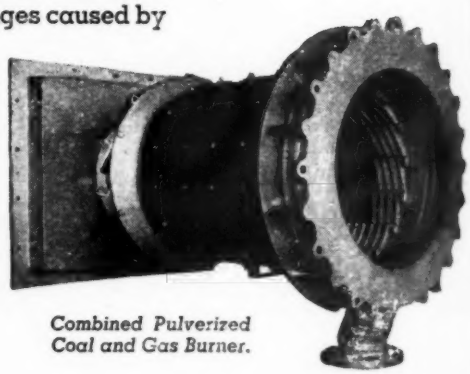
MAKE FUEL CONVERSION AN ADVANTAGE

PEABODY has been building burners for firing pulverized coal since 1924. Advances in design and materials of construction have kept pace all these years with progress in steam generating equipment. This is important now when increased coal firing of boilers has become necessary to conserve other fuels.

The Peabody Coal Burner, due to the manner in which fuel and air are controlled, produces a short, extremely turbulent flame, which results in highly efficient combustion.

Peabody Combined Fuel Burners are supplied in types that fire coal, oil or gas including blast furnace gas, in any combination through a single furnace wall opening. They eliminate the need for future equipment changes caused by fuel shortages and give the widest flexibility in the choice of fuels for the life of the boiler.

Discuss your combustion problems with Peabody engineers, who have concentrated on burner equipment for many years.



Combined Pulverized Coal and Gas Burner.

PEABODY ENGINEERING CORPORATION

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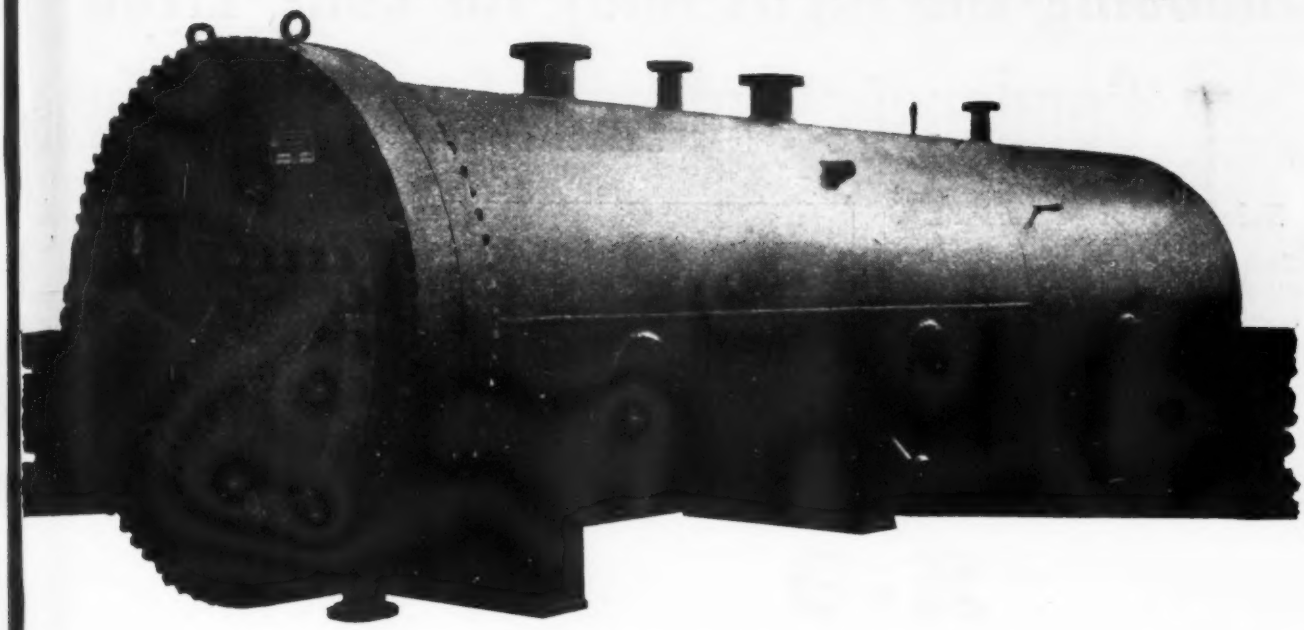
PEABODY LIMITED, LONDON

For SUSTAINED CAPACITY...PURITY of Boiler Feed Make-Up



BENTUBE EVAPORATORS

EXAMPLES OF G-R PIONEERING

Coil-type Water Heaters
Stationary Make-up Evaporators
Scale-shedding Evaporators
Finned-tube Exchangers
Exchangers for Dirty Fluids
Scale-shedding Coolers and Condensers

SUSTAINED CAPACITY . . . without laborious hand cleaning . . . is maintained in G-R Bentube Evaporators by their thermal scale shedding feature.

SUSTAINED PURITY is assured by experienced design for proper balancing of disengaging area . . . headroom . . . vapor velocity . . . and other vital factors.

G-R BENTUBE EVAPORATORS have many additional advantages . . . rugged construction . . . readily accessible joints . . . efficient vapor separators . . . easy withdrawal of tube bundle.

These typical design features make G-R Evaporators of all types widely preferred . . . as evidenced by more than 3000 stationary and marine installations.

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GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 6

Choosing the Right Alloy for Long-Lived Condenser and Heat Exchanger Tubes

Selection of Material

The selection of the alloy for any particular service, will depend upon the conditions under which it must operate. The many factors which must be considered in this connection have already been discussed. It is evident that each application of tubes in a condenser or heat exchanger is an individual problem which must be studied in detail before any specific recommendation can be made regarding the most economical and satisfactory tube material for use in the particular case. An investigation of this kind would cover not only a survey of all the known service conditions but would also take into consideration the alloy previously used and the type or form of corrosion previously experienced in the unit in question or in similar units operating under similar conditions. It is obvious that the subject can only be treated in a very general way without a consideration of all the essential facts which might apply to an individual case. The following information, therefore, is designed principally to give some indication of the conditions under which available condenser tube materials have given satisfactory service. In most cases it will be noted that two or more alloys may be used under a certain set of service conditions; in certain services, it is true that a rather wide choice of tube materials may be made without any appreciable difference in operating costs or service life. In other cases, where corrosion of some form is particularly severe, selection may be limited to one or possibly two of the more refractory materials.

Muntz Metal:

Nominal Composition, Copper 60%; Zinc 40%. Muntz metal tubes have been used extensively in both fresh and salt water service in steam condensers operating at relatively low temperatures. Use at the present time is confined chiefly to steam condensers at inland stations with fresh circulating water from rivers, lakes or wells. Muntz metal also has good resistance to hydrogen sulphide and other active sulphur compounds but is seldom used in applications where corrosion by such compounds is severe primarily because other factors, such as high temperature, high velocities, badly contaminated waters, etc., are usually active at the same time. Failure of Muntz metal tubes occurs usually as a result of gradual dezincification of the layer type. Muntz metal tubes in fresh water steam power plant installations have had a service life of twenty years or more.

Admiralty Metal:

Nominal Composition, Copper 70%; Zinc 29%; Tin 1%. This alloy has excellent corrosion-resistant properties and is used widely in tube form in such diverse services as: steam condensers using fresh, salt, brackish or acid mine water for circulating purposes; heat exchangers, coolers, etc., in oil refineries where corrosion from sulphur compounds, acids and contaminated waters may be very severe; feed water heaters, heat exchanger equipment in industrial processes, etc. Admiralty metal tubes are often used in apparatus operating at temperatures of 400°F. or higher although severe dezincification of the alloy may be experienced under certain service conditions at elevated temperatures. Admiralty metal has a tensile strength of approximately 50,000 pounds per square inch in the finished annealed condition, together with excellent ductility. The strength of the alloy is retained up to a temperature of approximately 300°C. (570°F.).

Phosphorized Admiralty Metal:

Nominal Composition, Copper 70%; Tin 1%; Phosphorous 0.03%; Zinc remainder. The addition of a very small percentage of phosphorus to admiralty metal increases the dezincification-resistance of the alloy to a marked degree without impairment of the excellent chemical and physical properties of the alloy. Phosphorized admiralty metal was developed, therefore, particularly for installations where severe dezincification of admiralty metal has been experienced or is anticipated. Combining as it does resistance to dezincification and resistance to corrosion by sulphur compounds, acids, contaminated fresh and salt waters, etc., phosphorized admiralty metal has found wide usage.

Red Brass:

Nominal Composition, Copper 85%; Zinc 15%. Red brass is sufficiently high in copper content so that it does not dezincify under normal service conditions; it is also not as susceptible to season cracking or stress-corrosion cracking as brasses of lower copper content

Scovill's Analytical "Service In Manuals" Helps Many Firms Save Scarce Tube Metals

Both before and after installation of condenser or heat exchanger tubes, success depends on expert knowledge of the exact interrelation of tube alloys with the service conditions. This article is part of Scovill's continuing "Tube News" series; all preceding issues, dealing with tube manufacture, causes of corrosion, etc., are available on request, together with Scovill's up-to-date "Condenser Tube Booklet" covering the broad range of problems bearing on tube life. Address, Scovill Manufacturing Company, 13 Mill Street, Waterbury, Conn.

and combines favorable physical and chemical properties to make it a very serviceable alloy for many heat exchanger installations. Red brass tubes have been used chiefly for service in contact with fresh waters although tubes of this alloy have also served very satisfactorily in uncontaminated salt water. This alloy is not generally recommended for use where corrosion by Hydrogen Sulphide or other active sulphur compounds is liable to be severe.

Deoxidized Copper:

Tubes of deoxidized copper (copper content 99.90%) are limited to applications where the high purity of the material is essential or where it is necessary to utilize the high thermal and electrical conductivity of pure copper. It has excellent resistance to practically all types of fresh water and to many chemicals. It is not usually serviceable in contact with salt water or active sulphur compounds. In the hard-drawn temper copper has a strength of approximately 60,000 pounds per square inch but it does not retain this strength at temperatures of 200°C. or higher.

Arsenical Coppers:

Nominal Composition, Arsenic 0.35%; Copper balance. The alloying of a small percentage (0.15–0.50) of arsenic with copper reduces the electrical and thermal conductivity of the copper 25% to 50%. Compared with deoxidized copper, arsenical copper has (1) a higher softening or annealing temperature (300°C. against 200°C.), (2) increased strength, hardness and stiffness of cold drawn material with no impairment of ductility, a higher fatigue limit, etc. Arsenical copper has been reported to be slightly more resistant to atmospheric corrosion than copper and equally as corrosion-resistant as copper in salt or fresh waters. Arsenical copper tubes find their principal usage in condensers and heat exchangers using fresh circulating water; they are not usually recommended for service in contact with hydrogen sulphide or other active sulphur compounds, with media carrying an appreciable percentage of organic acids, particularly in the presence of air (oxygen) or with acid solutions of an oxidizing character, such as acid mine waters. Their chief advantages over deoxidized Copper for heat exchanger service are (1) greater strength, (2) better resistance to erosion and abrasion, and (3) higher softening temperature.

Aluminum Brass:

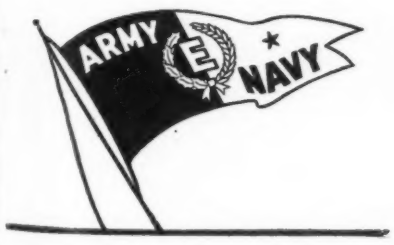
Nominal Composition, Copper 76%; Aluminum 2%; Zinc 22%. The addition of approximately 2.00% of Aluminum to Brass of the above copper content, improves the resistance of the resulting alloy very materially, particularly to corrosion by salt and brackish waters and to combined erosion and corrosion in salt water service. The excellent corrosion resistance of this depends upon the nature of the film which develops over the surface of the tube. In service, this surface film is of the desired properties (thin, adherent, continuous, compact) to give excellent protection to the metal even under very severe water conditions; in addition the film is self-healing in case of a local breakdown, such as might occur through abrasion or erosion of the metal surface, making tubes of this alloy very serviceable in installations where tubes of other alloys might suffer rapid localized corrosion. Aluminum Brass tubes have been used quite extensively during the past ten years in marine condensers and in steam condensers of tidewater stations where relatively high velocities of the circulating water, together with turbulence and air bubble impingement, have a particularly severe local wearing action on Admiralty metal and other brass tubes.

70-30 Copper-Nickel:

Nominal Composition, Copper 70%; Nickel 30%. Tubes of this alloy are used in heat exchanger equipment under conditions where severe wear and corrosion have been experienced, particularly at elevated temperatures and at high velocity of the circulating media. Copper-Nickel tubes have given excellent service, for example, in ship condensers of the U. S. and British Navies, in steam condensers of tidewater stations where brackish or salt circulating waters are very corrosive, in various oil refining units operating at relatively high temperatures and in contact with corrosive materials, etc. 70–30 Copper-Nickel combines excellent corrosion-resistant properties with very favorable physical characteristics, such as high strength and extreme ductility. The strength of the alloy is retained even at relatively high temperatures. The thermal conductivity of this alloy is approximately one third that of Admiralty metal; actually, however, the heat transfer coefficient of a new unit is reduced only slightly when Copper-Nickel tubes are used in place of Admiralty metal. Some designers of heat transfer equipment allow 5% more tube surface area when Copper-Nickel replaces Admiralty or other brass tubes. Copper-Nickel tubes are not subject to season cracking or stress corrosion cracking so they may be used with safety either in the finished annealed or hard drawn condition. The preference at this time is for finished annealed tubes.

80-20 Copper-Nickel:

Nominal Composition, Copper 80%; Nickel 20%. The Copper-Nickel alloy containing 20% nickel has similar physical and chemical properties to the 70-30 Copper-Nickel and is, therefore, used in the same type of service, i.e., in marine and tidewater steam condensers, in oil refining installation, etc. The corrosion-resistant properties of the alloy are not equal to those of the higher nickel alloy so that the 70-30 alloy is still generally used under extremely severe conditions. In many cases, however, conditions may not be severe enough to justify the use of 70-30 Copper-Nickel and in such cases, 80-20 Copper-Nickel may give economical and satisfactory service.



THIS IS NUMBER SIX in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

GETTING A "FIX" ON THE FUTURE

WE'RE getting a "fix" on the future by setting our sights on today's horizons.

In recent years practically every branch of industry has witnessed vast technological changes, many of which have been greatly accelerated by war's unrelenting demands. New vistas have opened—new processes been devised—new products developed. And it has been our privilege to cooperate in the application of Carborundum Brand Super-Refractories to many of the furnaces utilized in conjunction with these processes.

At present, we are busy filling the refractories requirements of war industries. Without interrupting our efforts in this direction, however, we find time to discuss plans for the future because we know that tomorrow's problems must be solved today. They cannot be put off until tomorrow for tomorrow would be too late.

Being fully cognizant of this fact many laboratories—many pilot plants—are already working on new and improved materials and equipment for the post-war period. In some of this work refractory problems will undoubtedly arise in the solution of which we would like to lend a hand.

The same technical aid extended to other furnace operators is likewise available to you. Why not write us today instead of waiting until tomorrow?

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District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Firebrick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fire Clay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

In the early days, this was the peak of streamlining.

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Streamlining adds more than beauty. For years, Reliance engineers have pioneered in streamlining electric motor-drives—*for utility and efficiency.*

Among recent developments are axial-flow fan motors, close-coupled pump motors, V★S Adjustable-speed Drive. These and other Reliance Motors are being used in many highly efficient installations where space is limited . . . where flexibility of power control and ease of operation are essential . . . where safety is a prime factor . . . and trim appearance desirable.

For further advantages of streamlined motor-drive and practical design suggestions, call in a Reliance man.

Reliance Splash-Proof D-c. Close-coupled Pump Motor. Pump is mounted right on the motor shaft—eliminates misalignment, saves space; fewer parts, less maintenance.

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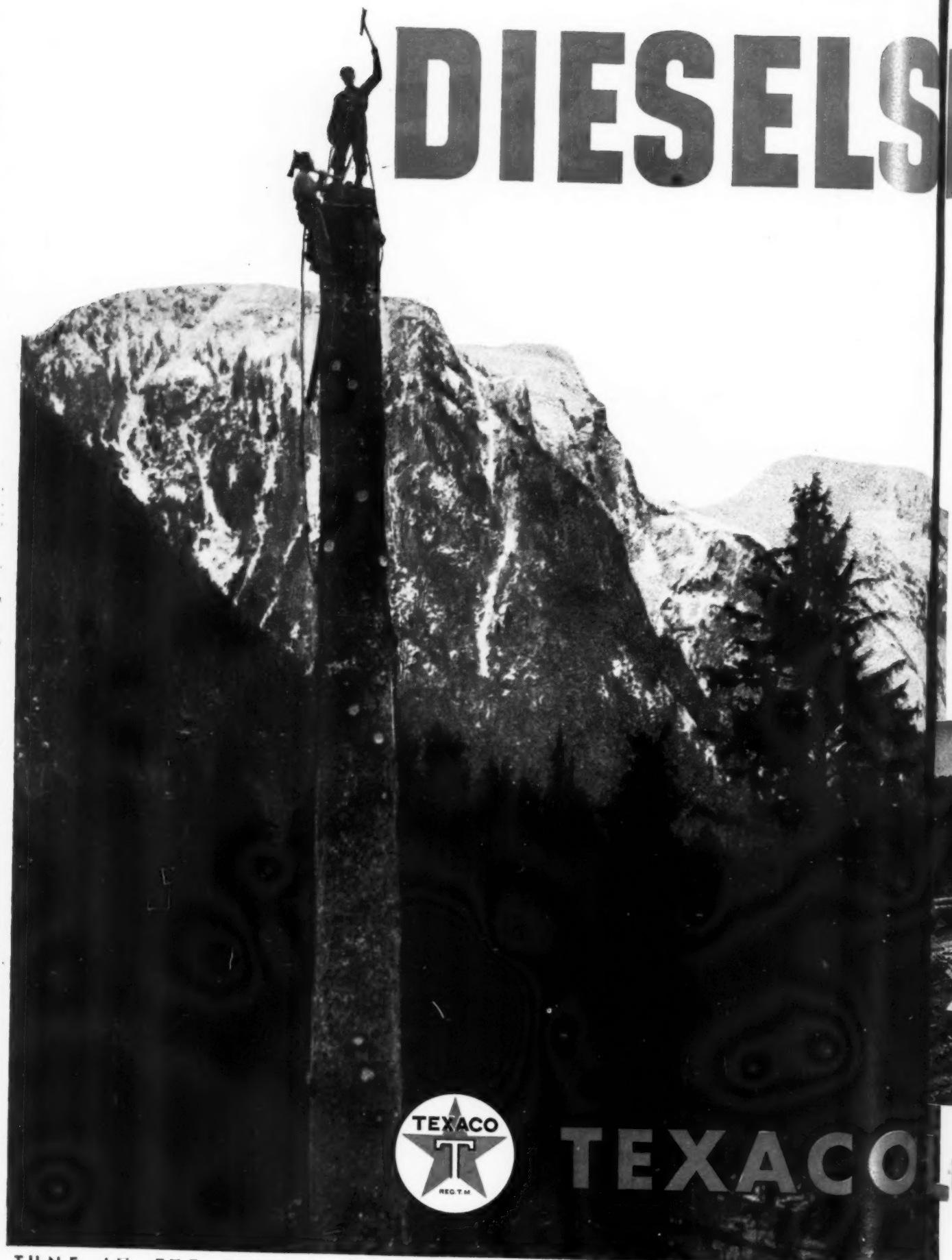

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—C

DRAG 'EM

MOSQUITO bombers in the rough, these hundred-ton spruce trees can be called real "war plants." Hauling these fallen giants out of the woods and to the mill is the job of Diesels.

In lubricating not only these high-speed Diesels, but also the large stationary units in power plants and pumping stations, Texaco is saving money for operators by assuring longer service between inspections and overhauls.

Increasing the life of rings, pistons, liners and bearings, both *Texaco Algol* and *Ursa Oils* keep rings free in their grooves, valves active, ports clear, assuring piston seal that means full power and maximum fuel economy.

Why not ask the cooperation of a Texaco Lubrication Engineer, available through more than 2300 Texaco wholesale distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ *More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.*

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FOR ALL DIESEL ENGINES

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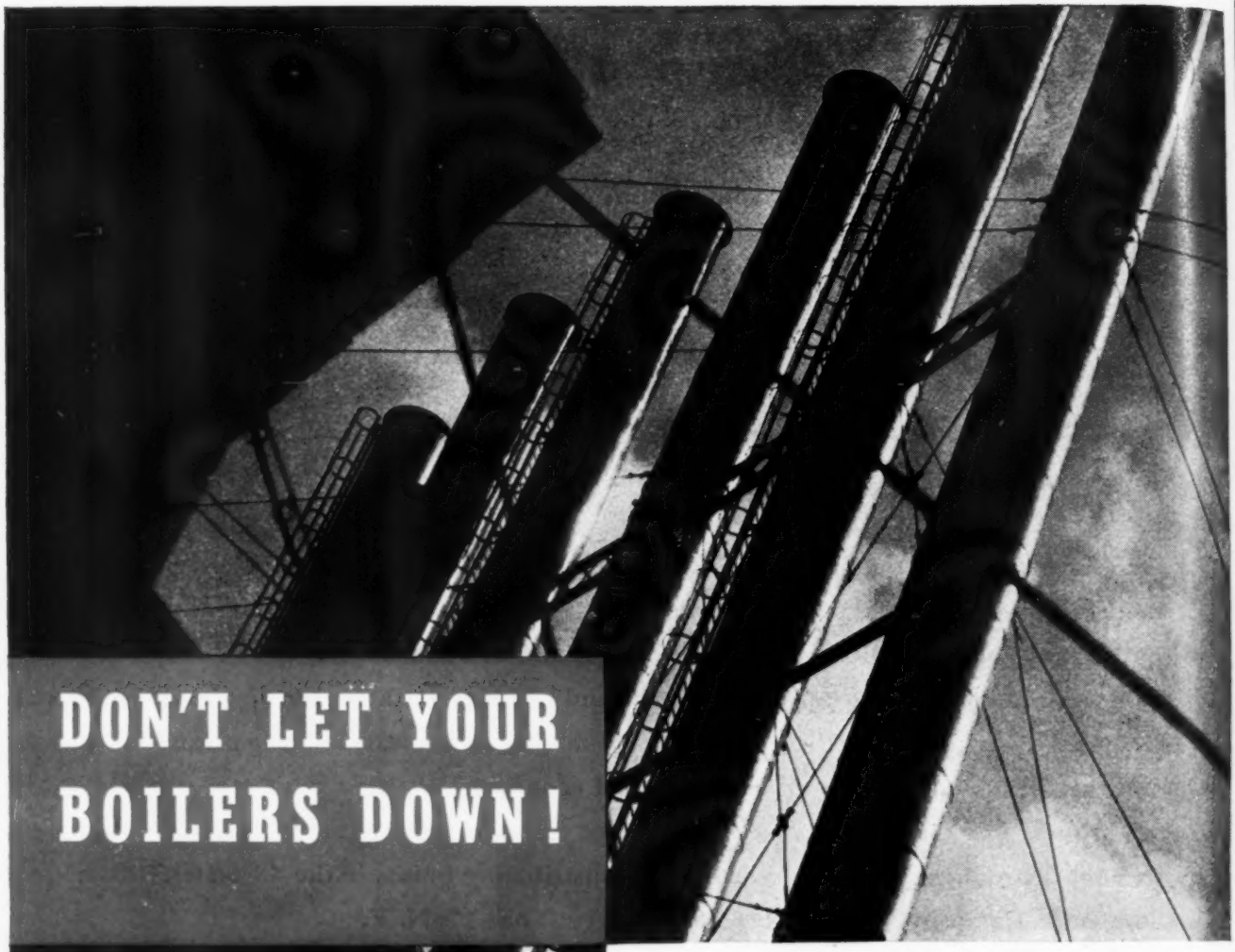

DON'T LET YOUR BOILERS DOWN!

Under wartime conditions, many boiler installations are working under an abnormal load, but they must continue to deliver with a minimum of time out for overhaul. Feed water that is exactly conditioned for your boilers will help reduce outage caused by corrosion, scale, embrittlement and carryover—will guard against costly failure.

Betz engineers and chemists know how to keep boilers operating 'round the clock. Years of experience with all types and sizes of installations and with widely varying feed waters enables Betz to render a boiler water service that is complete for all industries, with individual recommendations for each client.

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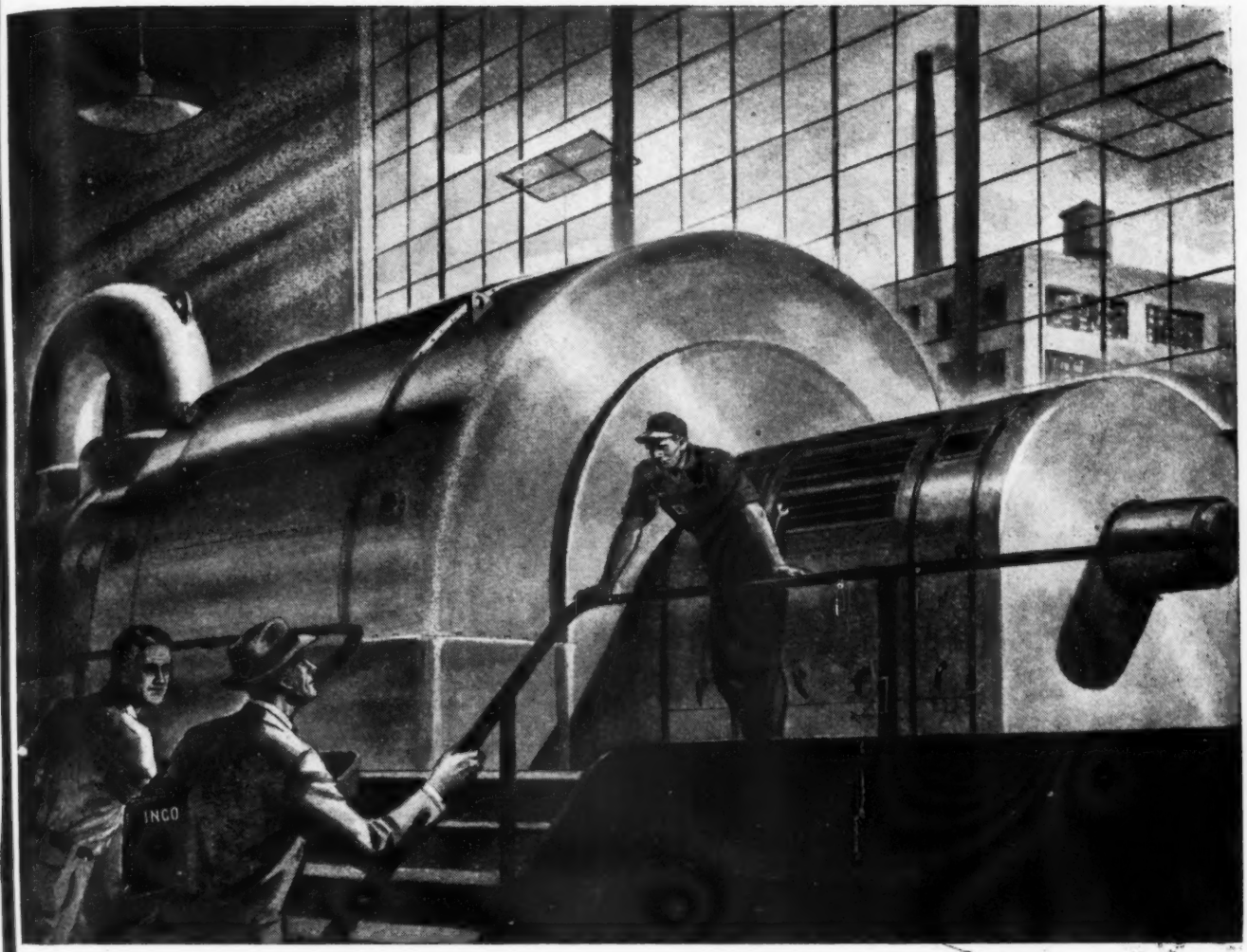

NICKEL AIDS THE POWER INDUSTRY

to KEEP 'EM OPERATING!

In this day of acute shortages of almost everything, power plant engineers are doing an amazing job of meeting demands for power—the power to keep 'em operating.

Part of this success is due to their foresight in specifying materials that assure long life and withstand the added hardships imposed by ever-increasing peak-load demands.

With the production of tanks, guns, and planes dependent upon power capacity, Nickel makes a valuable contribution towards uninterrupted operation, through the improved properties it imparts to ferrous and non-ferrous alloys used in power plant equipment.

So today the exigencies of war illustrate more clearly than ever the simple truth of the familiar axiom, "A little Nickel goes a long way" toward increasing the dependability of power plant equipment, from turbine blades to high pressure valves, from flange bolts to shaft forgings.

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New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects—from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

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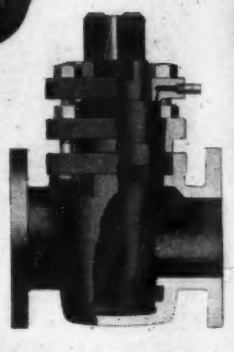
ASBESTOS-PACKED COCK

Easy TO OPERATE THIS COCK ...it never sticks



Cross section of the body of the cock showing the location of the U-groove. Cock in main illustration has double gland feature. Top gland holds plug at pre-set pressure and the second gland independently compresses the gland packing.

The plug of this READING-PRATT & CADY double gland Asbestos-Packed Cock turns, even when used infrequently, with a fraction of the effort required to operate a ground cock. Yet it holds a constant, tight seal.

This is accomplished by the **U**-grooves of Asbestos which, in addition to providing this *tight* seal, minimize friction and provide a cushion to absorb expansion differential between plug and body.

Use it in lines that carry solids in suspension; for viscous fluids, oils, acids and alkalis. Paper mills, steel mills, packing houses, oil refineries, soap, dye-stuffs and by-products plants use it in many of their process lines—wherever globe, angle or gate valves fail or ground cocks prove unsatisfactory.

In addition to the iron illustrated above, designed for manufacture in bronze, cast steel, Ni-Resist cast iron and copper-free Ni-Resist cast iron.

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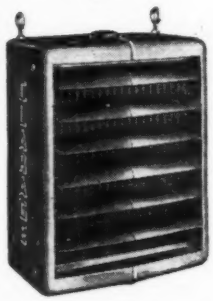
A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

So Unnecessary

to let your production slip this winter . . .

BECAUSE OF POOR HEATING!



CLARCO (PROPELLER FAN TYPE) UNIT HEATERS—ideal for heating any small factory area. Easily installed in any idle space—at any level. Fan designed to deliver maximum of heated air with minimum power. Heating coil equipped with lead coated heavy gauge steel tubes. Also suitable for offices—very quiet in operation.

UNITHERM UNIT HEATERS—designed for wide area heating. Built for floor installation as shown, or for location along side walls or at ceiling. Equipped with centrifugal fans—one for each outlet. Fans mounted on single shaft turning on ball bearings. Heating coil good for pressures up to 200 lbs. Working parts accessible. Outlets adjustable for 4 different directions of heat flow.

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Buy More War Bonds!

Don't let absenteeism, due to colds and other winter ailments, and time losses and spoilage, due to numb fingers, cripple your vital production schedules during the cold months ahead.

* *Make sure of comfortable temperatures throughout your plant by putting in modern equipment such as Clarage Unit Heaters.*

* Whether you have an entire plant to heat, or require a few units to help out a present system, the ease with which Clarage Unit Heaters can be installed and their higher heating efficiency should make them your first choice.

* Clarage has pioneered many improvements. All are incorporated in our present line of heaters. Syncrotherm Control (patented), to mention but one, is tremendously important. It enables you to maintain UNIFORM temperatures. No cold floors; no heat wastage at ceiling! Fuel costs are drastically reduced.

* *Look into the many advantages of Clarage Unit Heaters NOW! 24 standard sizes, operating on steam or hot water . . . very prompt deliveries. No obligation to have Clarage engineers submit complete recommendation—write, or phone us today!*

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VENTILATION
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FACTORY HEATING
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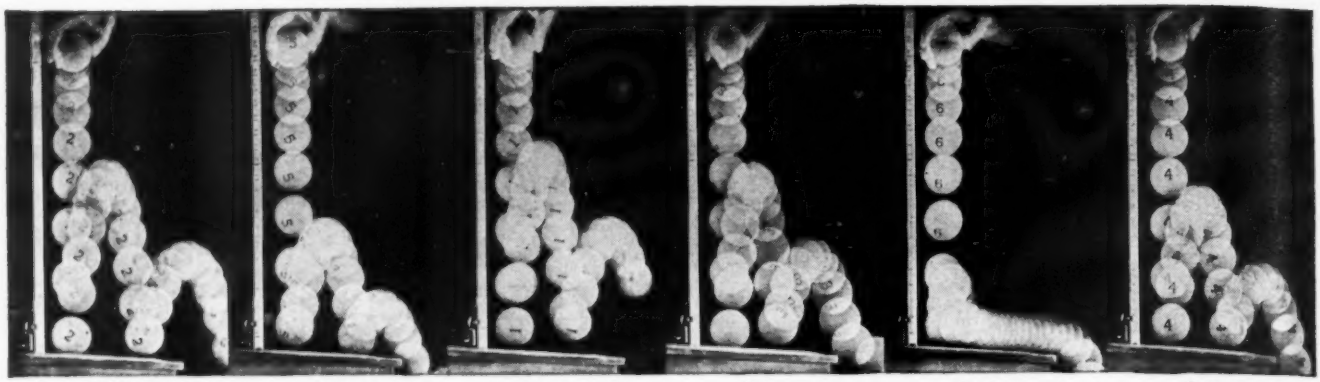
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

BOUNCE, BALLS, BOUNCE!



2 (Synthetic) 5 (Synthetic) 1 (Natural) 3 (Synthetic) 6 (Synthetic) 4 (Synthetic)

SIX SOLID BALLS OF RUBBER caught in the act of bouncing by a high-speed camera that shoots at the speed of 1/6592 of a second. All of them were dropped from exactly the same height...and yet, what a difference there is! One of the balls is made of a compound containing natural rubber. Each of the other five balls contains one of the five major types of synthetic rubber.

Can you pick out which of the balls is made of the rubber used in making Army barrage balloons? Which rubber is being used today for making tires for military and essential civilian cars? Which one is used for bullet-sealing gasoline hose? Which for insulating tape? Which for making lacquer hose? Try your skill. You will find the answers to these questions in the box at the bottom of this page.

SYNTHETIC RUBBER IS NOT JUST ONE NEW KIND OF RUBBER

It is a whole family of new materials each with its own important uses

Bounce the balls as much as you please. One bounces high. One bounces low. One bounces in between. Which one is best? Actually, there is no one "best kind" of rubber for every purpose. Without all of these main types of synthetic and natural rubber, it would be impossible to beat our enemies and bring our victorious men home as swiftly as possible.

The rubber industry, the chemical and petroleum industries, the Government, working as a team, have made this achievement possible. By pooling all their experience with synthetic rubber, their resources, their skill, they have broken the threat of "rubber shortage" the Axis counted on to throw us out of the war. More than that, they have produced types of synthetic rubber that can do special jobs better than they have ever been done before... and for all time declared our independence from any future cut-off of the nation's rubber supply.

That is the true meaning of the synthetic rubber program. We are proud to have contributed our experience and our resources to doing this job... and doing it in record-breaking, history-making time.

What the future holds for synthetic rubber is not yet fully known. Yet this much is certain. When the war is won, the knowledge we are gaining every day through the use of all these synthetic rubbers, alone and with natural rubber, will make peacetime products... whether tires for your car, belts for your factory, waterproof footwear for your children, or gasoline hose for your service station...better and more serviceable than they have ever been before.

THEY MAY LOOK LIKE "SIX OF A KIND" BUT HERE ARE THE ANSWERS TO THE WAR JOBS EACH ONE CAN DO

1. This ball was made with natural rubber...today used in limited quantities in combination with synthetics because of our small reserve stock.

2. Used for tires, conveyor belts, fire hose and many other products. It is most like natural rubber and can be quickly and efficiently processed.

3. Used for making solvent and lacquer hose and other products where the utmost resistance to solvents is needed...better than natural rubber for these purposes.

4. Used for making bullet-sealing fuel hose for planes and for other uses where high resistance to aromatic fuels is essential.

5. Used for coating barrage balloons, tank linings, packings, acid hose, wires and cables. This type does not support combustion and is highly resistant to sunlight and chemicals.

6. Used for insulating tape, molded parts. It is soft, pliable and odorless.

Listen to United States Rubber Company program, featuring New York Philharmonic Symphony Orchestra, Carl Van Doren, and a guest star, broadcast over Columbia network every Sunday afternoon 3:00 to 4:30 P. M. Eastern War Time

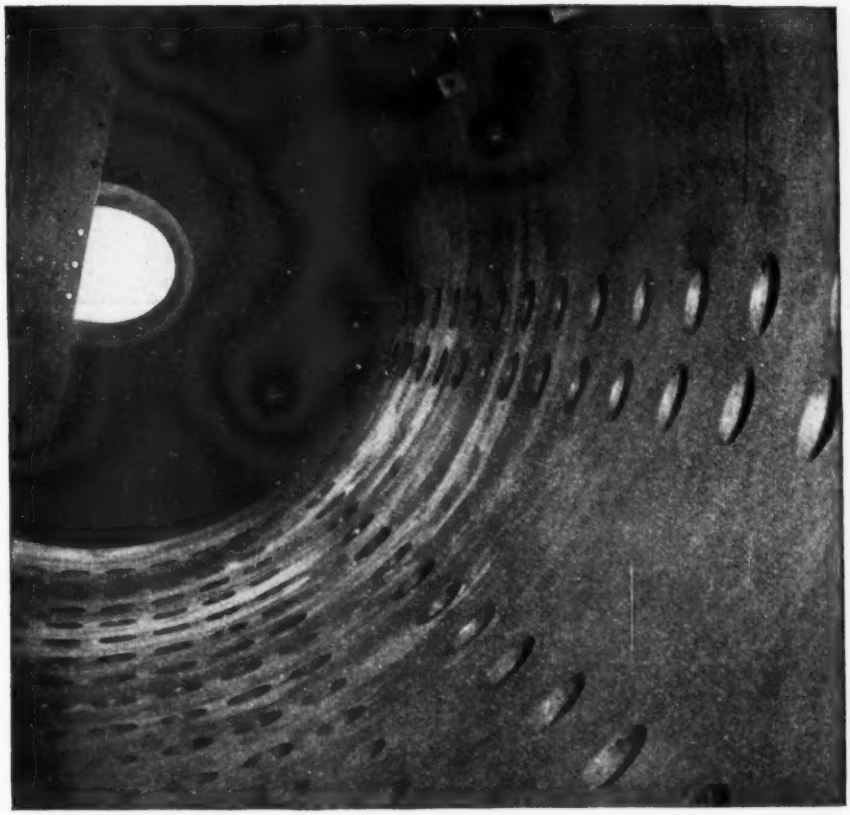
1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

THE NATION'S BIGGEST STOCK PILE OF RUBBER IS STILL THE RUBBER ON OUR CARS AND TRUCKS...CONSERVE YOUR TIRES!

In Canada: Dominion Rubber Company, Ltd.

UNITED STATES RUBBER COMPANY

YEARS OF EXTRA LIFE FOR OLD BOILER METAL



APEXIOR Protective Coating adds years of active service to any boiler that can pass inspection and a hydrostatic test.

Before you condemn that "worn-out" boiler — practically irreplaceable today — find out whether APEXIOR can keep it on the line for years' more useful life.

Hundreds of prominent power users have kept their "veterans" in service at top ratings during the present emergency by applying APEXIOR after testing and cleaning.

It's *available* — we have enlarged our facilities to meet the metal shortage. It's *recommended* by boiler insurance companies. It's *economical* — let us quote you figures. And, above all, *it keeps those war-essential veterans on the line* — for the duration!

3 Easy Steps In APEXIORIZING Old Metal Against Wear, Corrosion

(1) Inspect and give boiler hydrostatic test. (2) Clean to bare metal. (3) Apply APEXIOR with a brush, by hand or power-coater.

You'll find APEXIOR (1) provides a tough, impervious barrier against boiler water, (2) prevents corrosion for as long as 2 to 3 years, and often longer between renewals, (3) prevents direct bonding of dirt and scale, being thus easy to renew after quick cleaning with a wire brush.

Before condemning any boiler, *test and APEXIORIZE.* It's the quick, low-cost mechanical way to add years of extra life to boilers in war service. Write for free bulletins 1290 (General), 1305 (Marine) with complete data.

A Few APEXIOR Customers

Over 80% of all orders for APEXIOR are repeat orders

War Shipping Administration
Defense Plant Corporation
Standard Oil Co. of New Jersey
Republic Steel Co.
Owens-Illinois Can Co.
Kaiser Co.
Ford Motor Co.
Philadelphia Electric Co.
Chicago Great Western Ry. Co.
Virginia Electric & Power Co.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

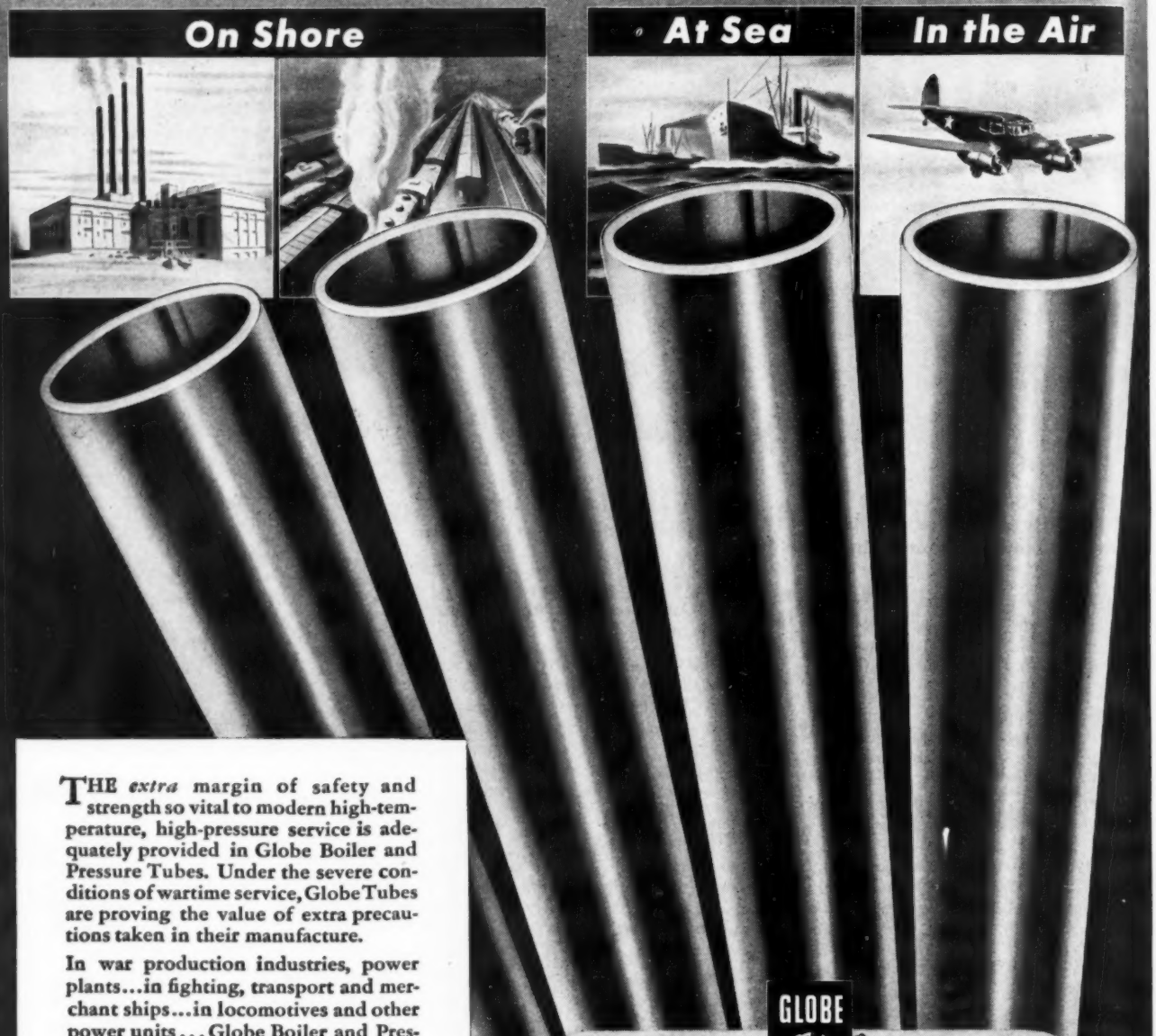
RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park, Mass.
Please send me free Bulletin 1290 (industrial) .....
Bulletin 1305 (marine) .....
Name .....
Company .....
Address .....

Main Office: **HYDE PARK • BOSTON • MASS.** • Branch Offices: **ATLANTA • CHICAGO • NEW YORK • DETROIT • PHILADELPHIA**
Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty Street, New York, N. Y.

STEEL TUBES THAT MEET THE EXTRA *Demands* OF WARTIME SERVICE



THE *extra* margin of safety and strength so vital to modern high-temperature, high-pressure service is adequately provided in Globe Boiler and Pressure Tubes. Under the severe conditions of wartime service, Globe Tubes are proving the value of extra precautions taken in their manufacture.

In war production industries, power plants...in fighting, transport and merchant ships...in locomotives and other power units... Globe Boiler and Pressure Tubes are meeting extra demands of service.

Globe mechanical tubing serves many critical needs in aircraft construction. Globe engineers can help you to select tubes with the exact characteristics you require—feel free to consult them. Their service is yours for the asking.

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

GLOBE TUBES

★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

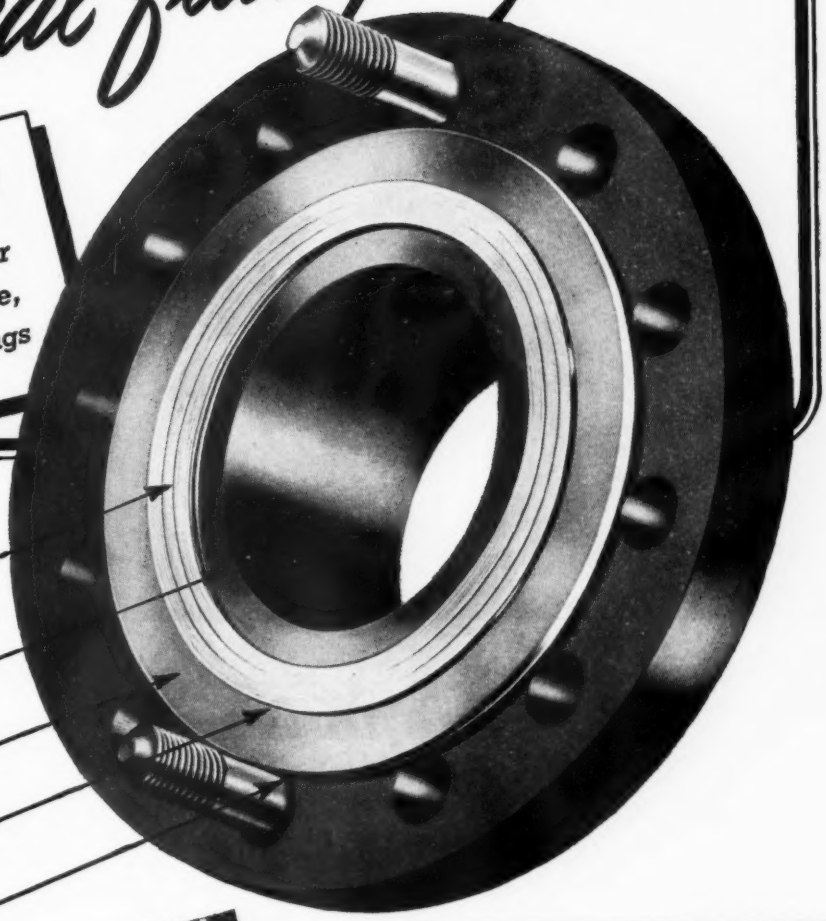
GLOBE STEEL *Tubes*

GLOBE STEEL TUBES CO., *Milwaukee, Wisconsin, U.S.A.*

This is the way to seal flanged joints

FLEXITALLIC "C-G" GASKET

...the safe, sure sealing member for Raised-Face, Smooth Face, Van Stone or Cranelap fittings



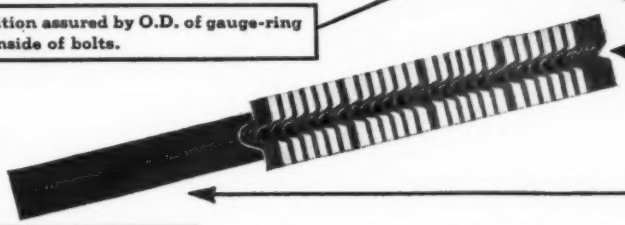
Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I.D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

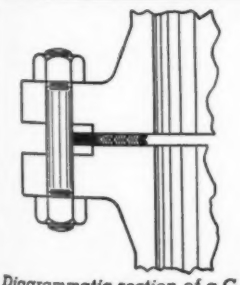
Fit of surrounding ring, allows inner member to expand under compression.

Correct position assured by O.D. of gauge-ring which fits inside of bolts.



Construction of each spiral-wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.

Gauge-ring saves installation time. Gasket is correctly installed when flanges are brought down to the ring in making up joint.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

In the period coming up to the war, Flexitallic engineers developed the C-G Gasket—a fortunate development in that the gasket was ready for war use. Production of C-G's has gone for war purposes, chiefly on ships, where the gaskets have saved many thousands of dollars in ship-construction time and have performed in a way which we want someday to report to you in detail.

Meantime, note the construction features of the C-G. A day will come when we will be able to deliver these gaskets plentifully for installation ashore as well as aboard ship—and you will want to have these C-G features helping you. We will be glad to send you a leaflet about them now; just say Style C-G Flexitallic Gaskets.

"Flexitallic" Reg. U.S. Pat. Office

Representatives in Principal Cities

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

Enlarged reproduction free on request

Thanks to America's Engineers

When certain pirates started picking off what they wanted in China, Africa, Europe and the Pacific—before coming at *us*—they figured that the U.S.A. couldn't do much about it. We didn't have enough ships to handle even 30% of our *peacetime* ocean traffic! How could *we* interfere!

But in twenty months, thanks to your help, America has broken all shipbuilding records. Fighting production workers in mines, mills, forests . . . in factories producing essential parts . . . in oil fields . . . and shipyards . . . have combined to accomplish the "impossible."

Continued success now depends on *maintaining* record-breaking production. The results are *beginning* to interfere with Adolph-Tojo plans. But America must not slacken its pace in producing the materials that go into the building and the operating of our Merchant Marine—the metals, timber, coal and oil, the marine equipment, and cargo for the ships.

Now it is up to all Americans to *finish* the job . . . and *fast*.

You Have Helped Us Do Our Part

We thank you, loyal customer, for conserving Wickwire Rope so that more can go to the Liberty Ships. But when you *need* new wire rope to maintain war production, tough, long-lived Wickwire Rope will always be available on priority, to the best of our ability.

• • •

Wickwire Spencer was first in New England to be awarded the Maritime M and Victory Fleet Flags for excellence in production of rigging for the U. S. Merchant Marine. A Gold Star has been added for maintaining that record.

Copyright 1943, Wickwire Spencer Steel Company, 500 Fifth Avenue, New York 18, N.Y.

WICKWIRE SPENCER STEEL COMPANY

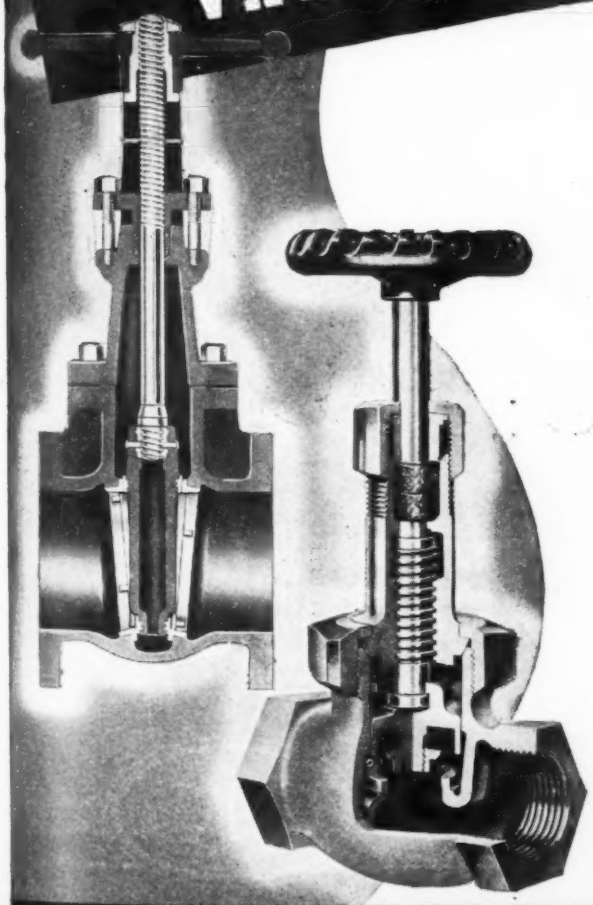
WICKWIRE ROPE

Sales Offices and Warehouses: Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles, Tulsa, Chattanooga, Houston, Abilene, Texas, Seattle. Export Sales Department: New York City

WISSCO PRODUCTS

PENTAGON BUILDING, ARLINGTON, VA.
Baker-Smith & Co., Inc.—Mehring & Hanson, Heating Contractors; Fred Brutschy Co., Plumbing Contractors; Carlson Bros., Power Piping Contractors; Charles S. Leopold, Mech. Eng.

World's Largest Office Building uses FAIRBANKS VALVES



The Pentagon Building, Arlington, Va., occupies a gross area of 6,000,000 sq. ft., has sixteen and one-half miles of corridors and houses forty thousand persons.

Uncle Sam put Fairbanks Valves to the "acid test", with the result that the majority of the valves in this gigantic structure are "Fairbanks".

Isn't the judgment of the men who chose Fairbanks Valves for this enormous building a safe guide for you to follow?

Fairbanks Valves are made in bronze and iron, in types and sizes for practically every service. Write for catalog No. 42 and name of our nearest distributor.

Back the boys at the front—Buy War Bonds

THE FAIRBANKS COMPANY
393 Lafayette St., New York 3, N. Y.
Boston, Mass. Pittsburgh, Pa.
Distributors in Principal Cities

Fairbanks *Standard and* Renewable **Valves**

Now...
STEEL VALVES
by
OIC

In its Cast Steel Valve plant in Wadsworth, Ohio, OIC is working around the clock for Victory and planning for the peace to follow.

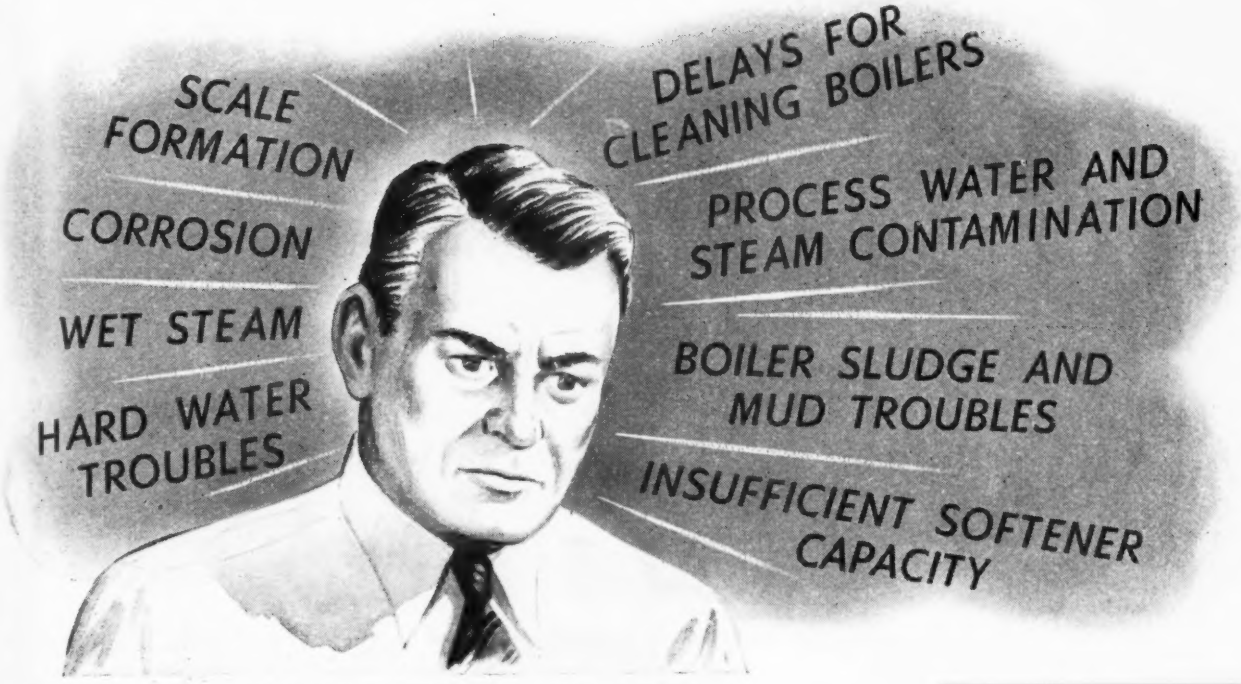
There is an OIC Distributor near you, ready to tell you of the exclusive features of design and construction of the OIC Cast Steel Valves. Call him today.

OIC

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

WHEN WATER TROUBLES GET YOU DOWN



—CALL THE ELGIN WATER CONDITIONING MAN

PEAK production schedules, shortage of skilled help and scarcity of equipment replacements, have imposed added worries on already overburdened plant engineers. But there's one worry you can escape. When water troubles get you down, call the Elgin Water Conditioning Man. He is an expert in handling water problems in your district and his services are yours for the asking.

As a pioneer in this field, our organization has had thirty-five years experience in solving water problems such as yours. Elgin products and methods cover every phase of water conditioning so that our recommendations are wholly unprejudiced—aimed solely at giving the results you want. We can prevent hard water troubles, scale formation, wet steam, corrosion, process steam contamination, and in fact, any of the troubles caused by improperly conditioned water. Elgin can take these problems off your hands and mind, for after all, water conditioning is our specialized business.

A COMPLETE LINE FROM WHICH TO CHOOSE

- Boiler Water Treating and Purifying Systems
- Feedwater Treatment
- Deconcentrators
- Heat Exchangers
- Water Softeners
- Filters and Purifiers
- Oil Removal Filters
- Iron Removal Equipment
- Aerators
- Water Treating Chemicals
- Chemical Feeders
- Scale and Corrosion Inhibitors
- Sample Coolers
- Water Testing Equipment
- Zeolites

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

Invest in America's Future Buy More War Savings Bonds

ELGIN WATER CONDITIONING FOR EVERY NEED

THE SOUTH NORWALK ELECTRIC WORKS

OWNED BY THE

Second Taxing District of the City of Norwalk, Conn.
Originally called Old Well
Recessed at the Indians Agni 2nd 1666
Formerly the City of South Norwalk 1890-1913

SUPPLYING
ELECTRIC LIGHTING AND POWER SE
TELEPHONE NORWALK 6-33 6-3
OFFICE AND WORKS, S
SOUTH NORWALK

OLIVER F. DORWARD
MARSHALL E. HOYT
J. A. O'CONNOR
BOARD OF ELECTRICAL COMMISSIONERS

E. J. SPLAN, GENERAL SUPERINTENDENT

August 28, 1943

Nordberg Manufacturing Company
Milwaukee
Wisconsin

Att: Mr. R. W. Bayerlein

Gentlemen:

It gives me pleasure to advise you that our two 3000 h.p. Nordberg enginss have given us completely satisfactory service.

We have never had a forced engine shutdown. They have demonstrated that they are capable of pulling their rated load, and more, at any time.

During the entire period of their operation these units have produced 13.62 Kwh per gallon of fuel and used 1 gallon of lubricating oil per 5200 b.h.p. hours. Our total cost for engine repairs to date has been negligible.

We have found your company readily cooperative in all respects.

Yours truly,

BOARD OF ELECTRICAL COMMISSIONERS

E. J. Splan

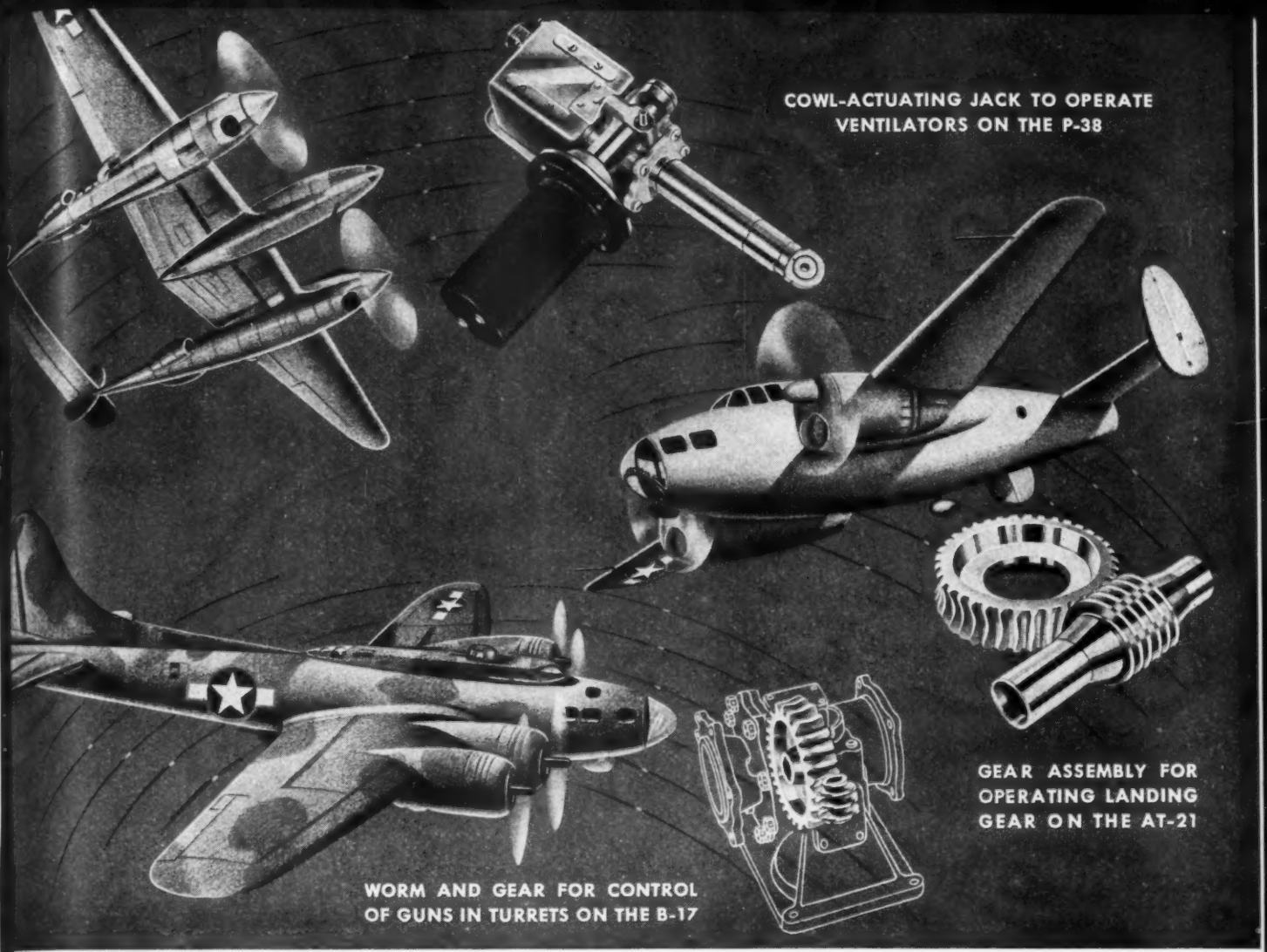
General Superintendent

EJS:MTG

"completely satisfactory service"

The City of South Norwalk installed its first Nordberg Diesel in 1940. A year later a duplicate unit was added. Here again, satisfactory performance has resulted in a repeat order for another Nordberg Diesel.

NORDBERG
DIESEL ENGINES


COWL-ACTUATING JACK TO OPERATE VENTILATORS ON THE P-38
GEAR ASSEMBLY FOR OPERATING LANDING GEAR ON THE AT-21
WORM AND GEAR FOR CONTROL OF GUNS IN TURRETS ON THE B-17

Production of Precision Aircraft Devices

SOLVING intricate production problems called for in the manufacture of high-precision aircraft devices is another contribution Foote Bros. Gear and Machine Corporation is making toward speeding the day of Victory.

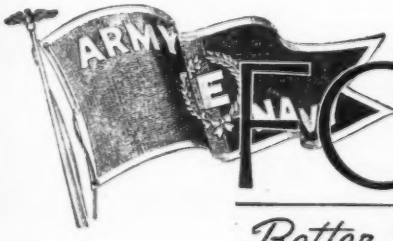
Precision gears for reducers for azimuth and elevation control of guns in turrets in the B-17 bombers—gear assemblies to raise and lower the landing gear of the AT-21 trainers—cowl actuating jacks to operate ventilators on oil coolers on P-38 interceptors—all these devices call for light weight coupled with extreme precision.

Foote Bros. engineering experience and manufacturing "know-how" acquired in the production of precision gears in tremendous quantities for Pratt & Whitney aircraft engines assure the production of these special devices in the quantities required to meet the ever-increasing demand of our global air force.

It is natural that many manufacturers of airplanes, airplane engines and airplane parts recognize in Foote Bros. a logical source for gears and devices where light weight and extreme precision are essential.

After the war, the experience gained in the manufacture of such gears and devices promises American manufacturers a new era in the economical transmission of power.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard • Chicago, Illinois

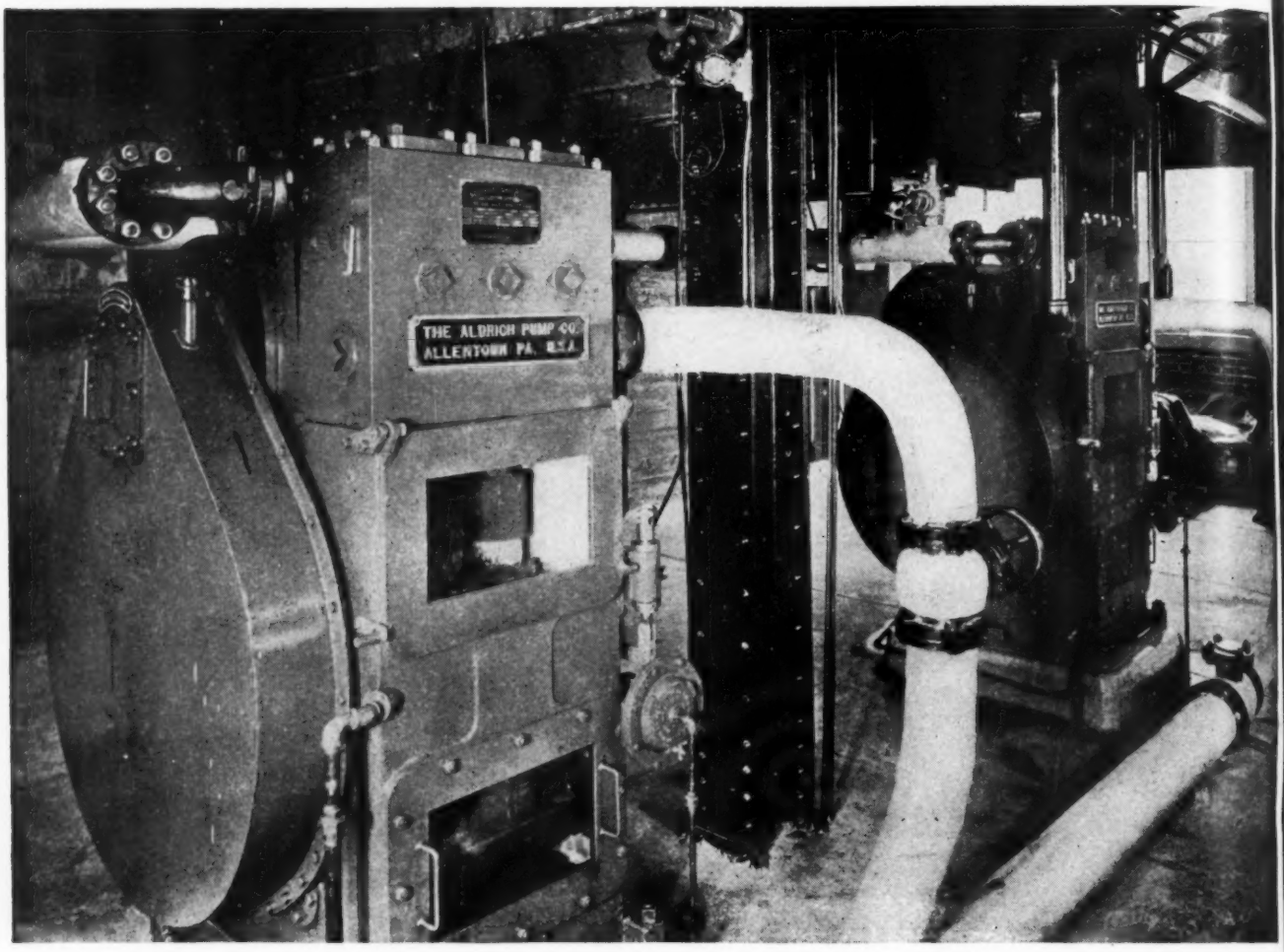


FOOTE BROS.

Better Power Transmission Through Better Gears

THESE ALDRICH-GROFF "POWR-SAVR" PUMPS...

TRADE MARK



. . . hold boiler water levels to close limits!

Typical Steam Flow Chart for a 24-hour period showing the widely varying steam demands from boilers fed by Aldrich-Groff Controllable Capacity "Powr-Savr" Pumps in a large eastern brewery.

EVEN with the widely fluctuating steam demands as indicated in the steam flow chart at the left, two ALDRICH-GROFF Controllable Capacity "Powr-Savr" Pumps have automatically maintained boiler water levels within one inch of the desired point as consistent practice during the more than 2 years of their operation to date. Each of these 0-to-4" *variable-stroke* vertical triplex pumps is driven by a 20-HP constant speed motor and feeds one 40,000-lb. per hr. boiler, with power consumption almost directly proportional to pump delivery.

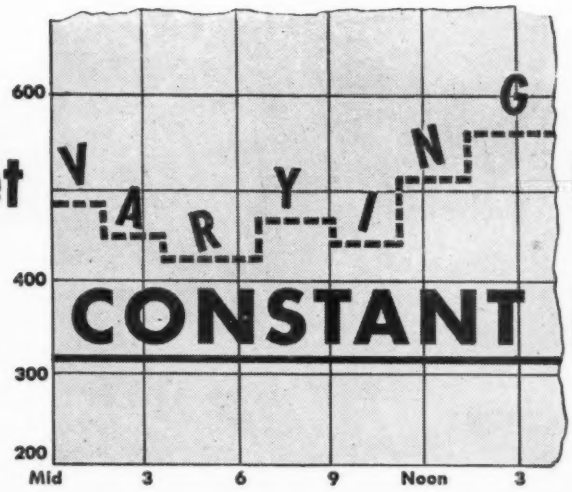
The use of these pumps with *unit feed systems* eliminates the pressure and power losses associated with throttling-type feed-regulating valves. The pump offers the advantages of feed system simplicity, efficiency and mechanical reliability for the small and medium boiler plant using medium and high steam pressures, and for *de-superheater feed service* in even the largest power stations.

And at sea these same advantages have called for the installation of Aldrich-Groff "Powr-Savr" Pumps on more than 100 ships.

Write today for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

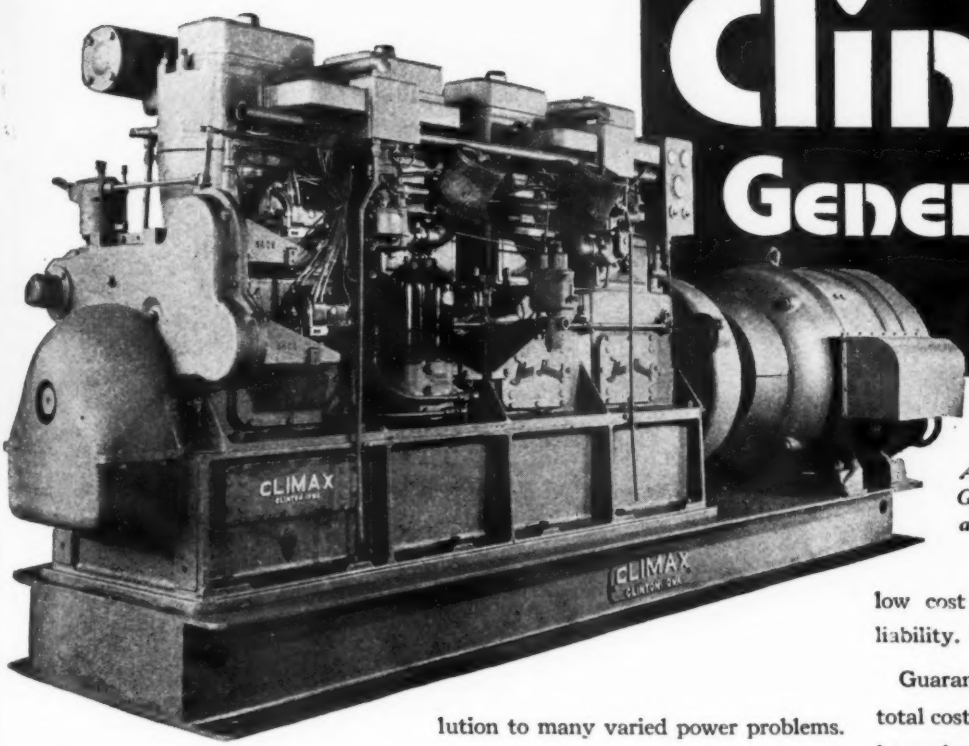
THE ALDRICH PUMP CO.

3 GORDON STREET
ALLENTOWN · PENNA.



Meet VARYING CONSTANT Load Demands and Get Reliability and Economy of Operation with

Climax Generating Sets



At left is a Model R8I Climax Generating Set used to furnish power and light for a large municipality.

To end peak load difficulties, eliminate transmission hazards and get cheap power, commercial and industrial power plants are depending more and more on the internal combustion engine.

Frequently, a Climax Engine and Generator has been *the* economical solution to many varied power problems.

With Climax Generating Sets you bring the power to the load. This prevents many difficulties which necessarily accompany purchased power. Outages due to power transmission are eliminated . . . Peak load difficulties and surcharges are prevented . . . Low generating cost is obtained, regardless of demand variations . . . Ability to operate at most economical load is assured and complete independence is won.

We are fully aware—that each power supply problem is an individual one and not solved by general theories. But the end result of every inquiry is to obtain low cost power with unquestionable reliability.

Guaranteed reliability and a reduction in total cost of power at the switchboard have been obtained time after time with Climax Generating Sets. Many of these Generators are functioning in municipal, private, institutional, manufacturing and other power plants. Except for the standby units, they are furnishing all power required and, in many instances, are quickly paying for themselves out of savings made.

"For High Achievement in the Production of War Material"

Climax Engineering Company

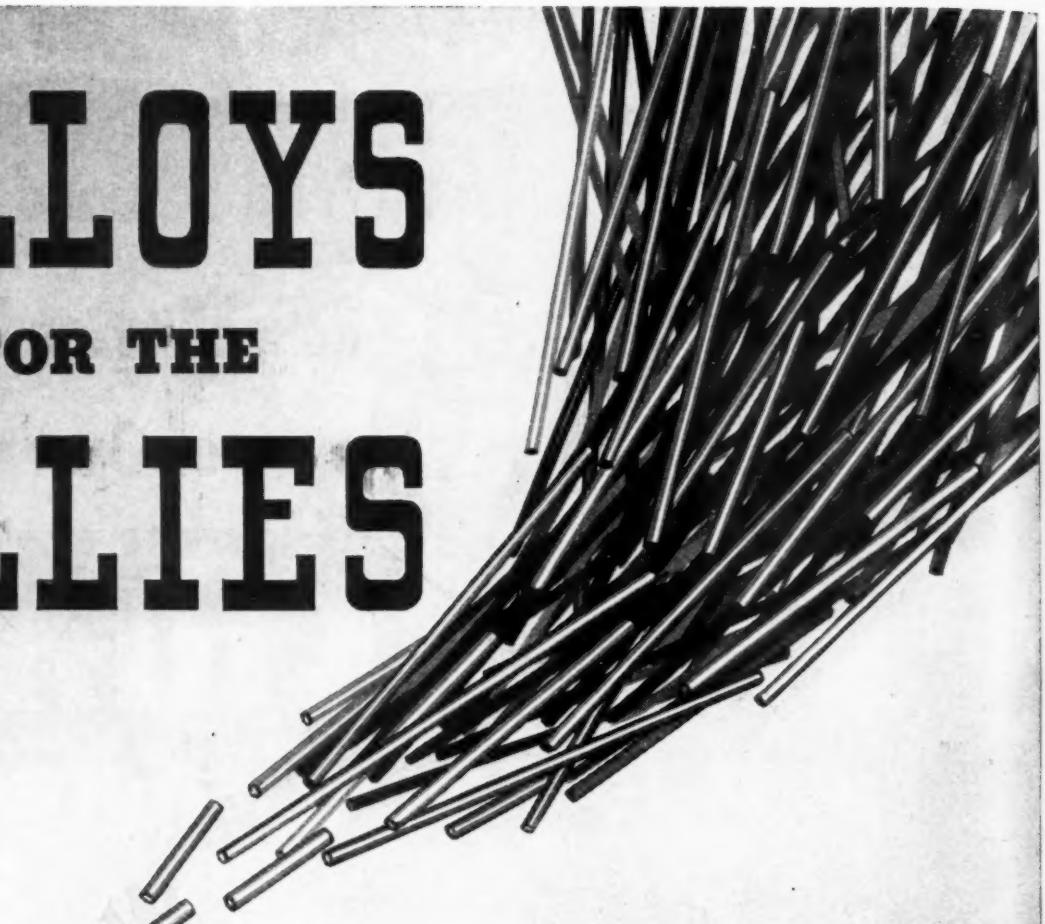
GENERAL OFFICES & FACTORY:
CLINTON, IOWA

REGIONAL OFFICES: CHICAGO, ILL., DALLAS, TEXAS

Climax Generating Sets are available in over 100 sizes and types from 300 watt to 312 kva.

Write Today to Climax for full details. Give load size and characteristics, nature of fuels available, auxiliary requirements and other particulars.

ALLOYS FOR THE ALLIES



CONDENSER TUBES

WOLVERINE PRODUCES CONDENSER TUBES IN THE FOLLOWING ALLOYS:

ARSENICAL BRASS "2 and 1" ALLOY
ALUMINUM BRASS "76/22/2"
PHOSPHORIZED ADMIRALTY
CUPRO-NICKEL "70-30"
ARSENICAL COPPER
"70 and 30" ALLOY
"85 and 15" ALLOY
"2 and 1" ALLOY
MUNTZ METAL
ADMIRALTY

CALUMET AND HECLA CONSOLIDATED COPPER COMPANY

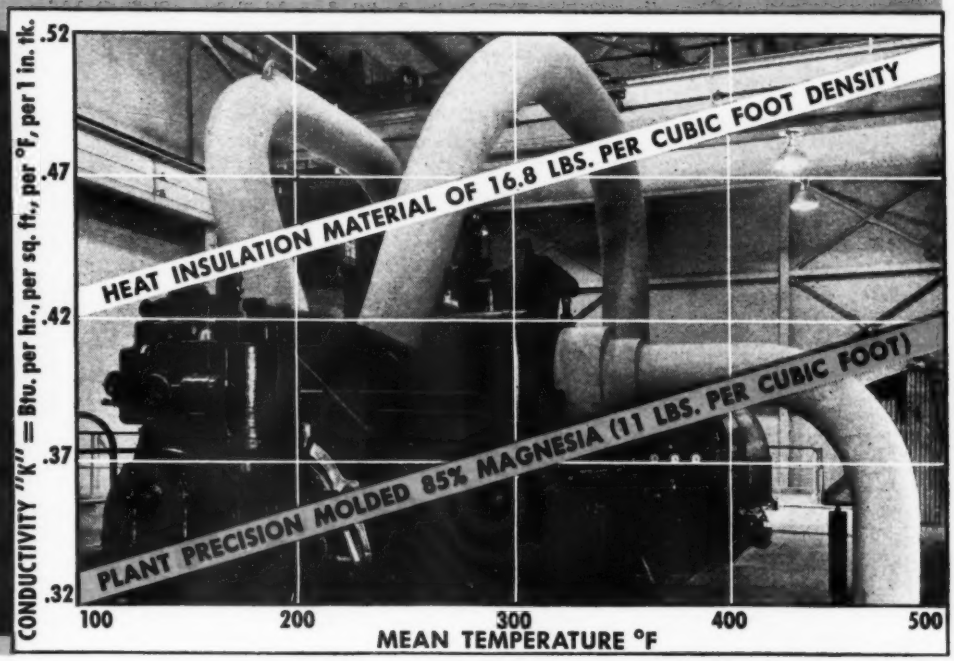
WOLVERINE TUBE DIVISION

Seamless Copper — Brass

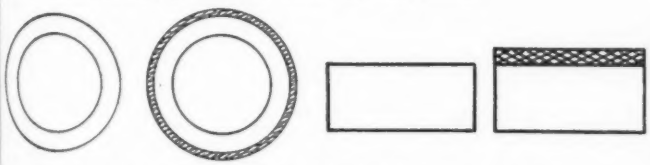
1435 CENTRAL AVENUE DETROIT 9, MICHIGAN

GIVES 29% BETTER HEAT INSULATION than ever before!

AMAZING NEW LOW IN THERMAL CONDUCTIVITY OVER THE FULL RANGE OF TEMPERATURES!



Heat losses drop to a new low—fuel savings soar to a new high—because the new, patented* Plant *Precision Molded* process revolutionizes the natural insulation superiorities of 85% Magnesia!



To give the same insulation result, material of 16.8 lbs. per cubic foot density would have to be approximately 29% thicker than Plant Precision Molded 85% Magnesia weighing just 11 lbs. per cubic foot density!

Here at last is unparalleled heat-insulating quality combined with unprecedented light weight! Here too are long-wanted advancements in uniformity, "ductile strength," durability and swift, easy application! To help you utilize the revolutionary advantages of Plant *Precision Molded* 85% Magnesia in your war work, our engineering staff will gladly submit calculations and specific recommendations. Write Today for details about this new standard of heat-insulation efficiency.

*U. S. Patent Nos. 2,131,374, 2,209,752, 2,209,753, 2,209,754

PLANT
PRECISION
MOLDED
REG. U. S. PAT. OFF.
85% MAGNESIA
"THE DEPENDABLE STANDARD—MODERNIZED"

COMPLETE RANGE OF SIZES AND THICKNESSES IN BLOCKS AND PIPE COVERINGS
(In sectional form up to and including 18-inch pipe size.)

PLANT
RUBBER & ASBESTOS WORKS

Manufacturers of Plant Insulating Materials and Mechanical Packings Since 1920

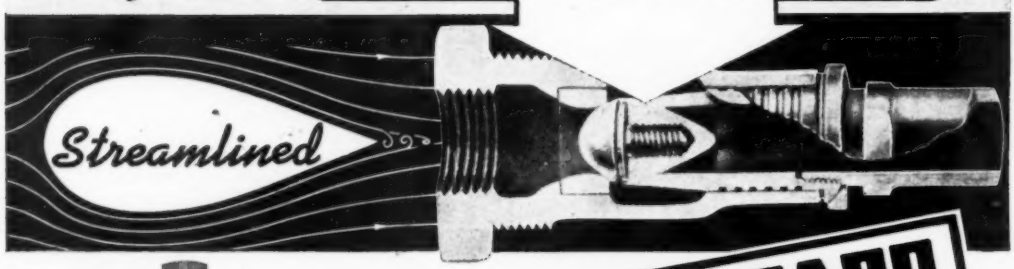
MAIN OFFICE: SAN FRANCISCO

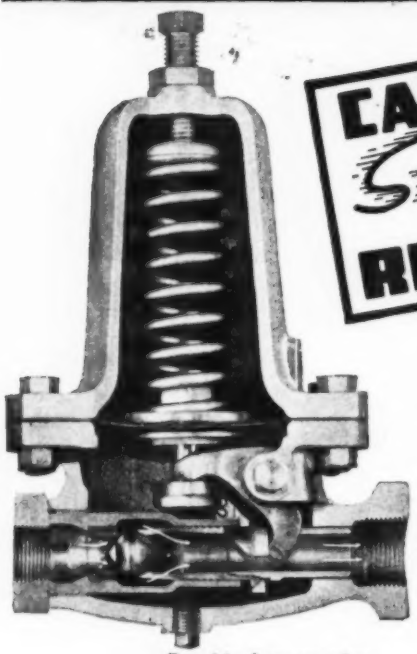
Sales Offices in Los Angeles, Wilmington, and Oakland, Calif.; distributors in principal cities.

Factories in Emeryville, San Francisco, and Redwood City, Calif.

Dependable CONTROL UNDER VARYING LOADS . . .

because of
STREAMLINED FLOW AROUND THE INNER VALVE





CASH STANDARD Streamlined PRESSURE REDUCING VALVE TYPE 1000

Accurate pressure control under toughest working conditions and maximum capacity when it is needed most are standout results users of the "1000" valve get day in and day out. This performance is made possible by the straight-line flow through the separate control chamber with its aspirating effect. This type of design is well worth your immediate investigation as a solution to your particular problem in the control of steam, water, air, oil, etc.

- Trouble-free service
- Smooth operation
- Tight closure
- Accurate regulation
- Elimination of failures
- Constant delivery pressure
- No spoilage
- Maintenance needs practically zero
- Speedier production results
- Cost-saving operation

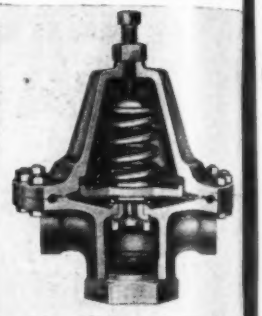
Write for Bulletin 1000 to get details on this Streamlined Valve for smooth even flow of steam, water, air, oil, etc.

LET US TELL YOU ALL ABOUT IT

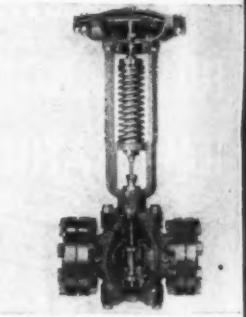
CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

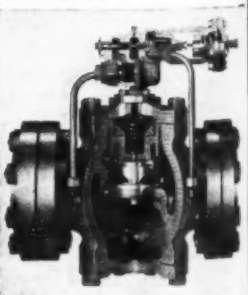
OTHER VALVES *from the* CASH STANDARD LINE



Type 8871 Pressure Reducing Valve; for use with liquids—especially dirty liquids, like Bunker C fuel oil for example. No sliding fits; inner valve bolted to diaphragm for positive movement. Initial pressure up to 250 lbs., reduced pressure up to 200 lbs. Bodies: iron, bronze or steel. Renewable inner valve and seat ring, stainless steel. Sizes: ½", ¾", 1".



Cash Standard Type 34, Pressure Reducing Valve. For practically all fluids. Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure, vacuum to 150 lbs.
Has roller guides, roller bearing — no lost motion.
Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type.



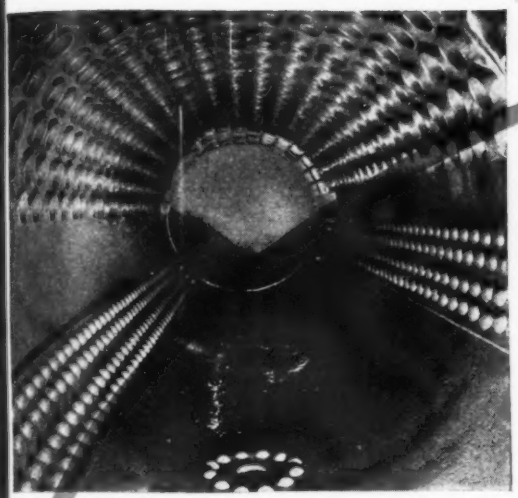
Cash Standard Type 11 Regulator, for use with water, air or any gas or oil that is non-corrosive. Pressure to actuate pilot valve may come from any source; and be as high as 1500 lbs.
Inlet pressure up to 600 lbs.; outlet pressure up to 250 lbs. Sizes: 2" to 12".

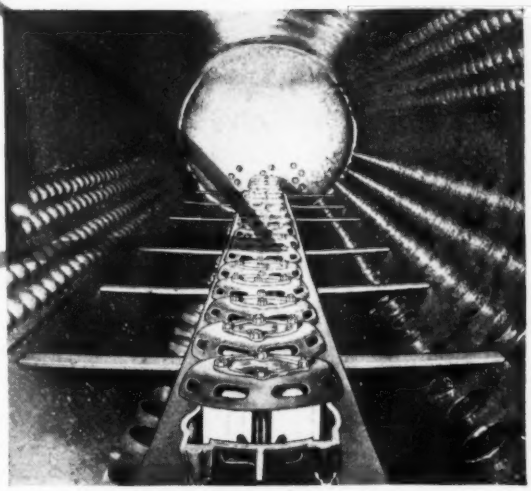
WITHOUT CHEMICALS

Submerged

BUTLER

De-Scalers*





Are

- **No water analysis necessary**
- **Definitely stops scale formation**
- **Positively causes the removal of old scale**
- **Stops foaming and priming**
- **Prevents electrolytic and oxygen corrosion**
- **Will not harden soft packing**
- **Will not corrode metallic packing**
- **Eliminates hand scaling, tube turbining**
- **Will maintain a proper pH value**
- **No long boiler shut down for cleaning**
- **No chemicals or Boiler Compound needed**

All De-Scalers used in accordance with our instructions will fulfill the above.

Photographs show top and bottom drums of a 830 HP Stirling Boiler operated at 2100 HP demand load equipped with De-Scalers.

KEEPING BOILERS PERMANENTLY FREE OF SCALE and CORROSION

The Butler De-Scaler is a scientific method of controlling scale, pitting, corrosion and other conditions that become evident in the operation and maintenance of steam boilers.

The Butler De-Scaler is composed of the elements of a galvanic cell. It is an entirely self-induced action, which naturally does not require any daily attention.

The submerged De-Scalers by their own self-induced action definitely removed all of the mineral scale-forming elements contained in the boiler water, preventing the formation of any new scale whatsoever, from that source. As a result of this action, we also have the gradual removal of all old mineral scale that may be in your boiler—regardless of the thickness or type of scale.

De-Scalers will prevent any and all types of electrolytic and oxygen corrosion not only in the boiler, but throughout the entire system. The Butler De-Scaler provides the most economical and efficient means of water treatment for all types of water.

Send for booklet **"Presenting Butler De-Scalers"**

THE DEMAND FOR GREATER BOILER ECONOMY HAS PLACED DE-SCALERS IN THOUSANDS OF BOILERS

Patented: other patents pending. Trademark Reg. U. S. Patent Office.

BUTLER ENGINEERING CO., 926 MAGAZINE STREET, NEW ORLEANS 11, LA., U.S.A.

Distributors with Stocks and Service in Important Industrial Centers throughout the United States.

Export Representatives: WM. McDONAGH & SONS, 180 FRONT STREET, NEW YORK 7, N. Y., U.S.A.

"LOCTITE" FUSE WEDGE

Solves the Fuse-Pressure Problem

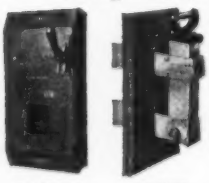
OVER 300 LBS. PULL BEFORE FUSE EVEN STARTS TO MOVE!

THE "Loctite" Fuse Wedge took a pull of 328 pounds before it started to move; the other fuse receptacle, 57 pounds (type "A" construction, too).

EC&M Switches of large amperage capacity—both Type "A" Safety Switches, and Type "A" Knife Switches—have this LOCTITE Fuse Wedge. It can't be lost—has no threads to strip—nothing to fall down across "hot" leads or terminals—is always available and easy to lock in position.

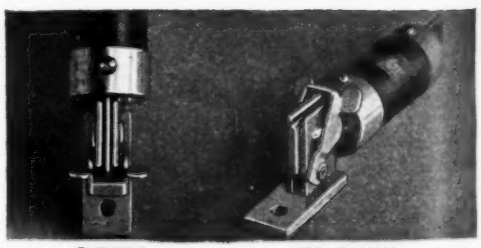
The heavy fuse-pressure prevents wattage loss—eliminates corrosion, discoloration, deterioration and heating which cause unnecessary blowing of fuses—combats vibration which lessens pressure and allows fuses to creep out.

Smaller sizes of EC&M Switches have fuse receptacles equipped with similarly efficient devices to insure high fuse-pressure. Ask for Bulletin 1300 for complete details on Safety Switches, Bulletin 1320 on Knife Switches.



SAFETY SWITCH

KNIFE SWITCH

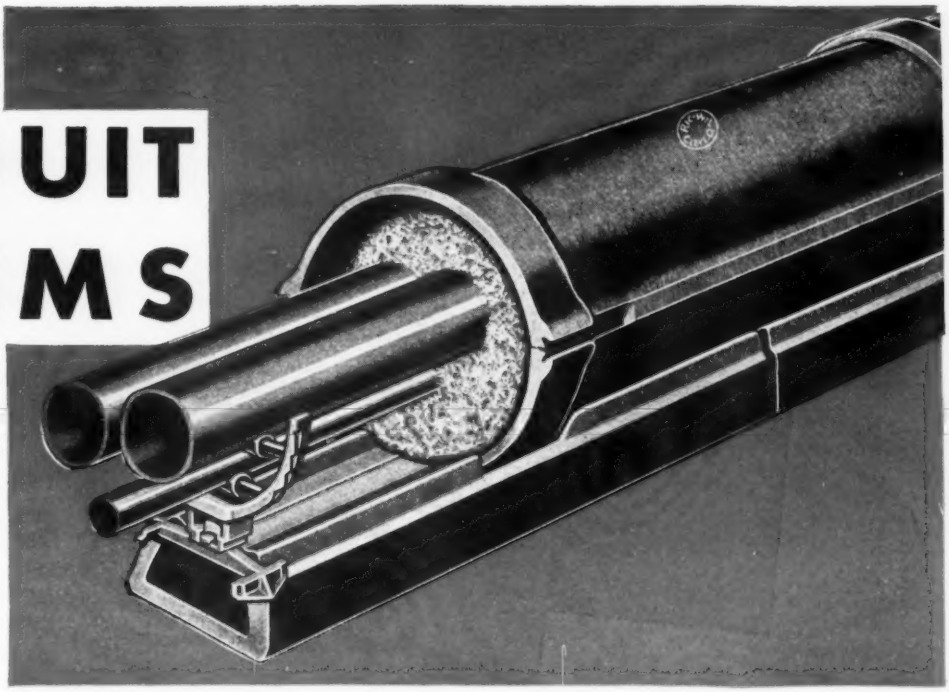


OPEN CLOSED

THE ELECTRIC CONTROLLER & MFG. CO.
2700 E. 79th St. Cleveland 4, Ohio

TILE CONDUIT SYSTEMS

FOR UNDERGROUND STEAM LINES



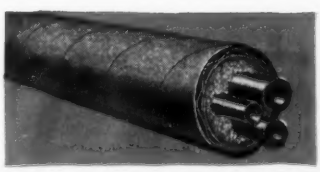
Ric-wiL, pioneer in the tile conduit field, has served the country's needs on underground steam protection with outstanding leadership since 1910. Today, with material supply, production facilities, and plant personnel subjected to severe pressure, it is a point of pride with us that traditional standards of quality are being scrupulously maintained. In spite of heavy demands, we are well equipped to make quick deliveries on all sizes and types of Ric-wiL Tile Conduit, as well as on our complete line of Prefabricated Insulated Pipe Units . . . Conduit illustrated is Ric-wiL Standard Tile with filler insulation. Heavy duty Super-Tile and Cast Iron are also available for this type, and all are adaptable to single or multiple pipe systems.

RIC-WIL TILE CONDUIT FOR OIL OR PROCESS LIQUIDS

In this system, conduit is insulated from the exterior, but individual lines are not insulated from one another. A steam or hot water line can thus maintain temperature to keep liquids flowing in the other lines. Insulation is a diatomaceous earth lining, moulded and keyed to inside circumference of tile. May also be used with fibre insulation for steam heat, power and superheated steam. Applicable to Super-Tile and Cast Iron.

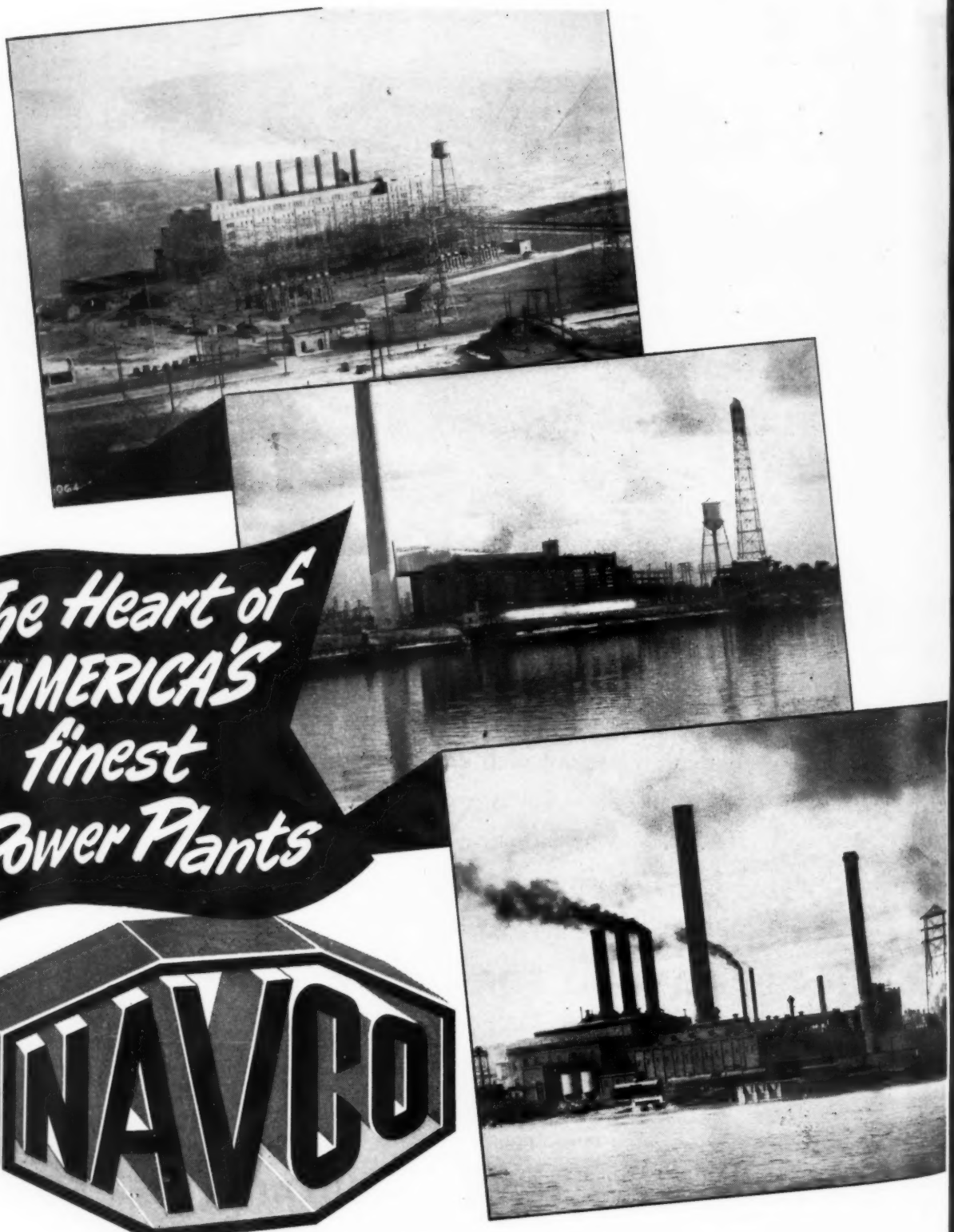
RIC-WIL PREFABRICATED INSULATED PIPE CONDUIT

Completely factory-prefabricated units including pipe and insulation as specified are furnished in convenient 21 foot lengths for speedy installation. Conduit is helical corrugated, coated with asphalt and wrapped with asphalt-saturated asbestos felt. This system is also available for oil or process liquids, and is adaptable to overhead as well as underground installations.



Many other types of Ric-wiL conduit are available to meet individual requirements. Write for complete information.

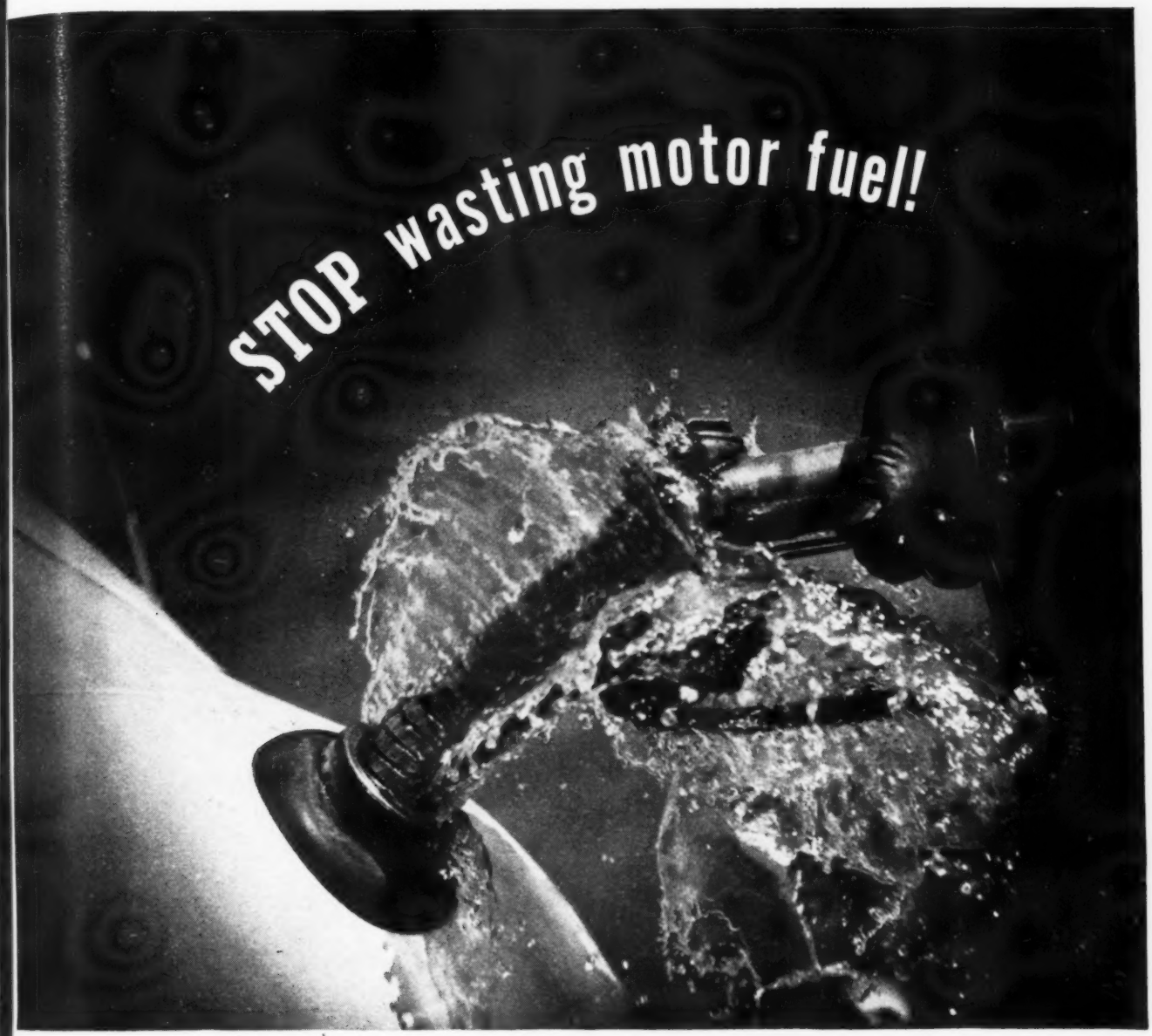
RIC-WIL INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES



NAVCO PIPING

NATIONAL VALVE & MFG. CO., Pittsburgh, Pa.

ATLANTA • BUFFALO • CLEVELAND • CHICAGO • NEW YORK • PHILADELPHIA



RING-FREE Motor Oil saves fuel 2 ways

RING-FREE REMOVES CARBON. Carbon on pistons, rings, valves decreases motor efficiency—leads to loss of power—wastes fuel. Macmillan RING-FREE Motor Oil *removes carbon* while the motor runs! That means better motor lubrication and substantial fuel savings.

RING-FREE REDUCES FRICTION. The 2nd thing RING-FREE does to save fuel is reduce motor friction fast! That releases more power to the drive shaft and really cuts fuel waste. Here's proof: In 1094 certified road tests, with various makes of owner driven cars, the average saving of *gasoline* was 1.3 miles per gallon after crankcases had been drained and refilled with RING-FREE Motor Oil. In many types of *Diesel* operations, as much as 25% reductions in operating costs (including fuel and maintenance) are reported. At the same time, oil consumption is reported decreased. Remember saving fuel is important — but beyond that, when it's better motor lubrication that saves fuel it also means a reduction of motor wear.

MACMILLAN RING-FREE MOTOR OIL

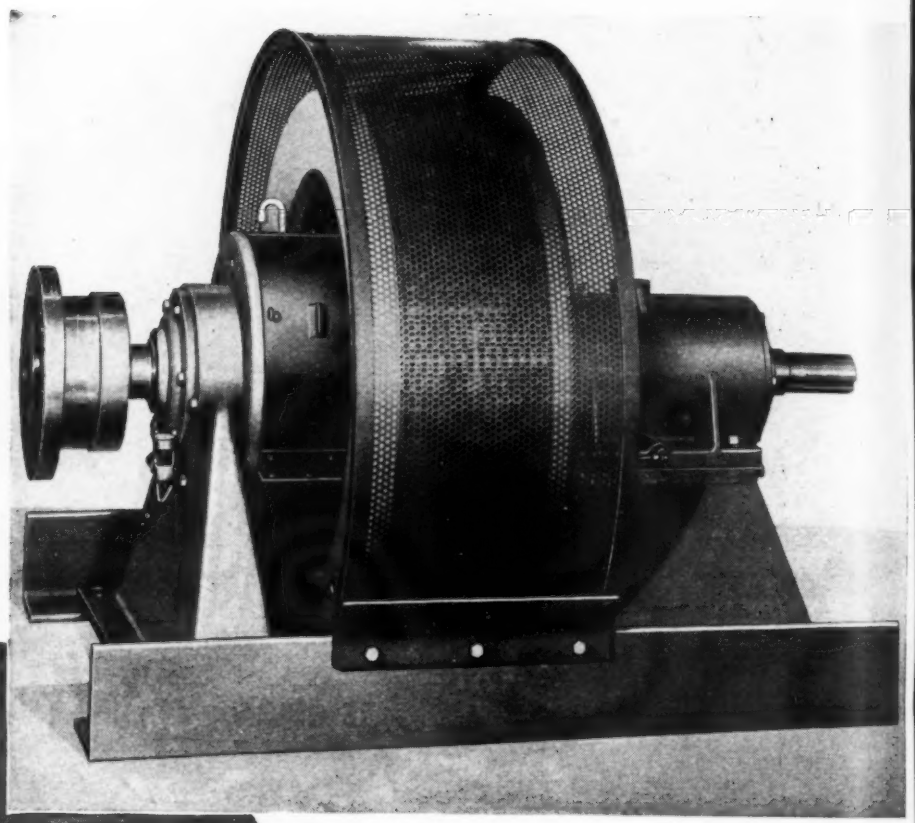
MACMILLAN PETROLEUM CORP.

50 W. 50th, New York; 624 S. Michigan Av., Chicago; 530 W. 6th, Los Angeles

Copyright 1943 Macmillan Petroleum Corp.

REDUCES WEAR BY REDUCING FRICTION

WHERE *War Plants get power* ON SKF BEARINGS



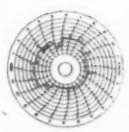
● *Built by*
DYNAMATIC CORP.

As you visit one public utility after another throughout America, you'll see this 500 h.p. at 1200 r.p.m. Variable Speed Dynamatic Coupling used as a variable drive for blowers and centrifugal pumps. But chances are you won't see the bearings. The center of one of the SKF Spherical Roller Bearings is mounted directly under the center line of the field member and the driving ring, thus balancing the magnetic forces exerted between the two members. Because this SKF is inherently aligning, any slight misalignment in the setup will not cause difficulty in operation, so long as the misalignment is not sufficient to cause interference in the air gap. Other SKF's are busy on other vital locations, but you won't see them. You know they're on the job after you scan the production records of the machines of which they are a part. 5377

SKF INDUSTRIES, INC., PHILA., PA.

PRODUCTION UP— COSTS DOWN at Iowa's largest milk plant!

BROS PROVIDES ECONOMICAL, RELIABLE and RESPONSIVE STEAM GENERATION



Steam Flow Chart

Steam Pressure Chart

Note Uniform Steam Pressure maintained through widely fluctuating loads.

In the capitol of the Nation's richest agricultural state, the Des Moines Co-operative Dairy Marketing Association operates Iowa's largest individual milk plant. Its processing runs into tonnage—an annual output of 2,250,000 pounds of butterfat—66,000,000 pounds of milk—2,700,000 pounds of dehydrated eggs. This kind of production calls for economical, reliable, responsive steam generation.

Wayne Wheeler, chief engineer, reports these facts. In 1932 the original equipment was replaced with Bros 263 H.P. water-tube boiler. In 1941 increased production demanded additional equipment and on the basis of nine years experience, Des Moines Co-op installed a Bros 3-drum, vertical-type, water-tube boiler, with water walls and clinker chills, 4,045 feet of heating surface, equipped with a three-unit Bros Super-Spred Stoker. The original Bros equipment is retained as a standby.

The record of Bros performance is detailed in the check list below. These facts and figures are worthy of study, worthy of comparison with your own operating records. If you have an immediate power problem of boilers or fuel feeding equipment, Bros can be of service with its single source of supply—its undivided responsibility for the complete job. Detailed literature on Bros boilers and spreader stokers is available. Write

WM. BROS BOILER & MFG. CO.
Minneapolis, Minnesota

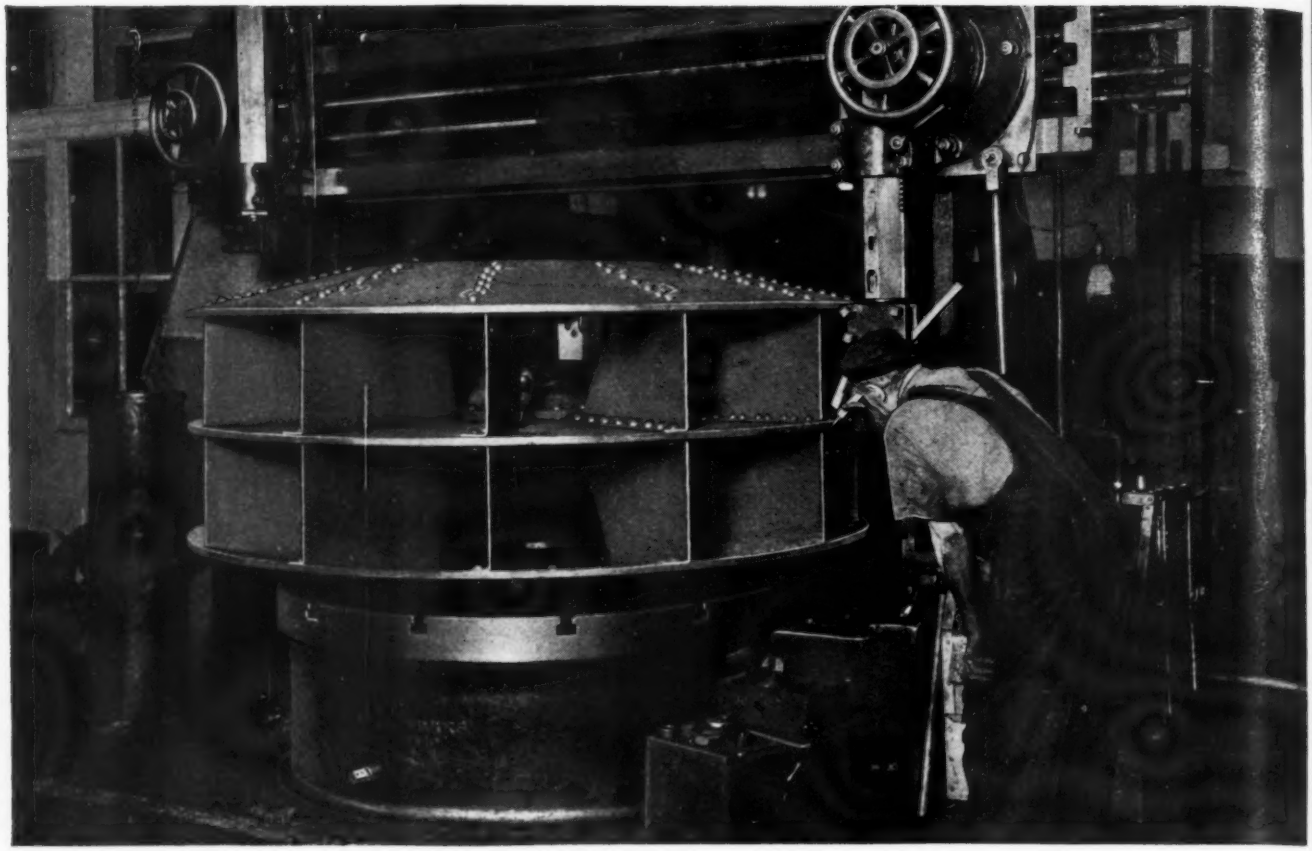
BROS PERFORMANCE CHECK LIST

How does this compare with your present operation?

	Des Moines Co-op Dairy Marketing Association	Your Plant
Widely Fluctuating Load	Runs from 100 to 200 per cent of rating with no appreciable change in steam pressure.	
Heavy Continuous Loads	Average load during peaks 800 H.P.	
Efficiency	Average continuous efficiency 73 per cent.	
Good Results Burning Cheapest Local Fuel	No slagging or clinkering with Iowa Coal of approximately 9,900 BTU, 18% Ash. Ash Fusion Temperature 2,150 degrees F.	
Low Maintenance	Not one cent spent for maintenance since installation, June, 1941.	

STEAM GENERATING UNIT WITH

BROS Super-Spred STOKER



It takes more than steel to make a wheel-

Conserve
. . . your fan equipment. This new "Buffalo" booklet gives full, illustrated data on correct installation and maintenance of fans.
Write for your FREE copy

You've got to have the right design to start with — and then your shop must have the "know-how" that comes only from experience.

At Buffalo Forge Company, where we've been building fans of all types for more than sixty years, this "know-how" is also a "know-why"—why certain blade shapes work better than others, why some rotors must be welded and some should be riveted —why a particular alloy steel — though it's hard to work and expensive — is worth it's cost on some jobs.

The hundreds and hundreds of jobs where Buffalo Fans are supplying 24 hour-a-day forced and induced draft for the boilers of America have given Buffalo engineers experience in every Industry.

The benefit of this accumulated experience is yours for the asking.

BUFFALO FORGE COMPANY
488 Broadway **Buffalo, N. Y.**
Canadian Blower & Forge Co., Ltd. **Kitchener, Ont.**

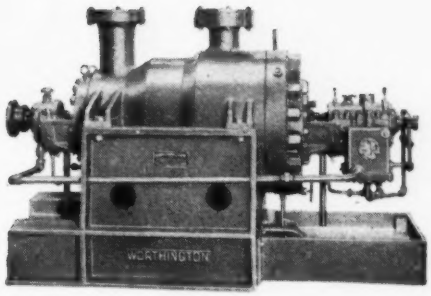
ARMY E NAVY

"Buffalo"

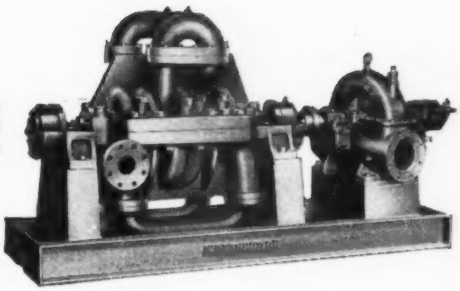
"First For Fans"

mechanical draft fans

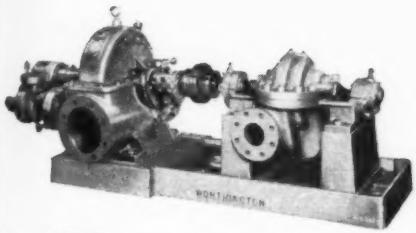
WORTHINGTON



Type WC *Multistage solid forged steel barrel boiler feed pump—capacities up to 3000 GPM—pressures up to 3000 p.s.i.*



Type UX *Multistage large horizontally split casing, axially and radially balanced boiler feed pump—capacities up to 1500 GPM—pressures up to 1250 p.s.i.*



Type UB-2 *two-stage horizontally split casing boiler feed pump—capacities up to 1500 GPM—pressures up to 450 p.s.i.*

COMPLETE COVERAGE in Centrifugal BOILER FEED PUMPS

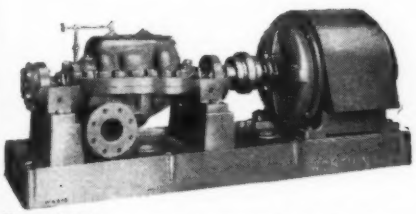
Worthington offers the power plant designer the most complete line of modern service-proven centrifugal boiler feed pumps.

This line includes horizontally split casing and solid forged steel barrel multistage pumps.

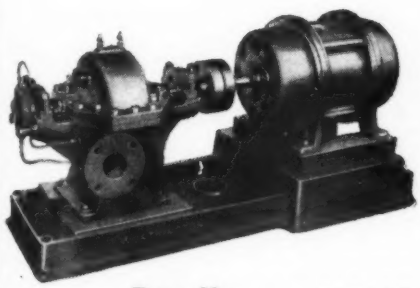
Worthington's position is unsurpassed on its preparedness to furnish *the correct boiler feed pump built of the correct materials* for any operating condition.

The types shown are but representative of the extensive Worthington line of centrifugal boiler feed pumps—many others are available.

Electric Motor or Steam Turbine Drive

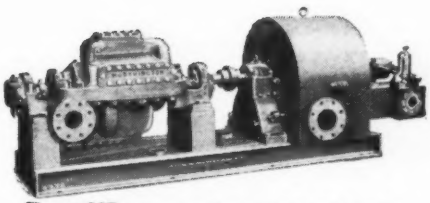


Type UQ *four-stage horizontally split casing boiler feed pump—capacities up to 1500 GPM—pressures up to 650 p.s.i.*

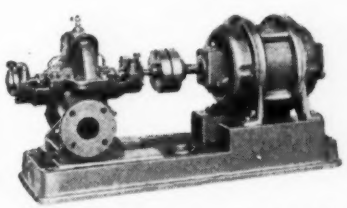


Type U *two-stage horizontally split casing boiler feed pump—capacities up to 300 GPM—pressures up to 250 p.s.i.*

Both the Navy E and Army-Navy E Awards have been presented to Worthington for speed and excellence in production.



Type UR *six-stage horizontally split casing boiler feed pump—capacities up to 750 GPM—pressures up to 800 p.s.i.*

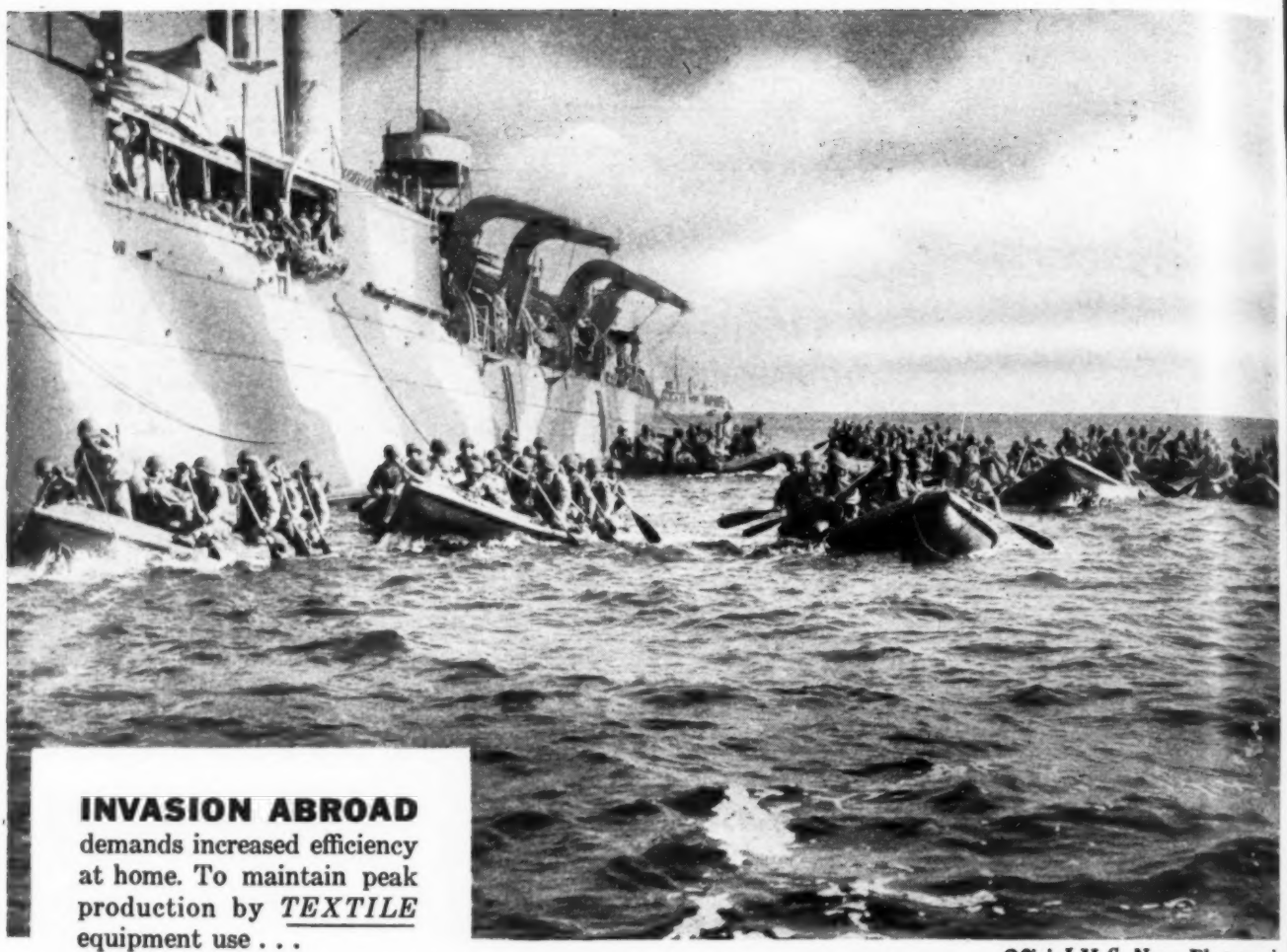


Type R *single-stage horizontally split casing boiler feed pump—capacities up to 400 GPM—pressures up to 200 p.s.i.*

MEMBER

CP3-6

WORTHINGTON PUMP AND MACHINERY CORPORATION • HARRISON, NEW JERSEY

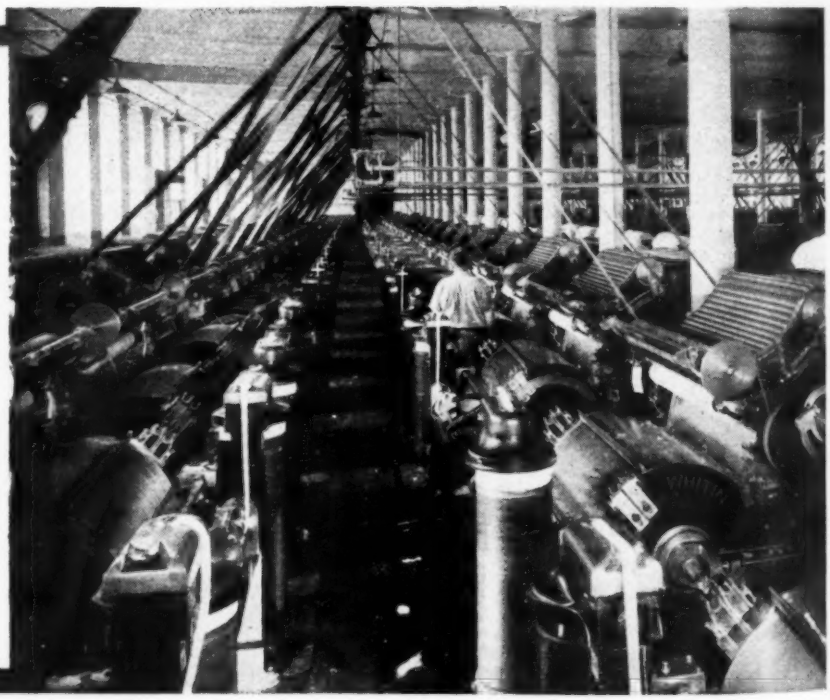


INVASION ABROAD
demands increased efficiency at home. To maintain peak production by *TEXTILE* equipment use . . .

Official U. S. Navy Photograph

. . . . . SINCLAIR LUBRICANTS . . .
Lily White Oils reduce spinning loads and power loss at all spindle speeds. No-Drip Lubricants for top rolls resist throw under severe operating conditions. Bearing Grease AF for plain bearings has the additional quality of being *water soluble* and *neutral* in color. Sinclair also provides quality oils for *Knitting Machinery.*

(Write for "The Service Factor"—published periodically and devoted to the solution of lubricating problems.)



SINCLAIR TEXTILE LUBRICANTS

FOR *FULL INFORMATION OR LUBRICATION COUNSEL WRITE* SINCLAIR REFINING COMPANY (INC.), 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Expanding your production facilities?

INSTALL DODGE-TIMKEN POWER TRANSMISSION EQUIPMENT

Dodge Modern Group Drive in metal-working plant. Shafts mounted in Dodge-Timken hangers.

Expanded production facilities usually mean extended power transmission lines.

When planning new power transmission systems specify Dodge-Timken line shaft hangers and pillow blocks. Then power will flow smoothly, steadily, uninterruptedly from source to job; power loss will be prevented; shafts will be protected against wear; radial, thrust and combined loads will be held in check at all times; lubrication needs will be minimized; there will be no leakage of lubricant, consequently no damage to product from this cause; maintenance will be reduced to the vanishing point.

Make sure you have Timken Tapered Roller Bearings at every suitable position in the machines themselves, too; then power will be able to exert its force for maximum production at minimum cost. The Timken Roller Bearing Company, Canton, Ohio.

Get the jump on post-war competition—redesign your equipment now and use more Timken Bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

All of American's Prints Are Ozalid Whiteprints

At American Airlines they speak of "the *whiteprint* of things to come." Here . . . print production is one hundred percent Ozalid—no blueprints.

They're making Ozalid whiteprints of their engineering and isometric drawings, weather reports, flight analyses, and office forms.

What's most important, they're saving time, labor, and materials.

WILL OZALID HELP YOU ALSO?

If your drafting output has reached the point where it would be more economical to do your own printmaking . . . by all means investigate the savings possible with an Ozalid whiteprint machine.

If you have already installed expensive blueprinting equipment . . . you can add a Dry Developing unit, which when used with your present Printer, will provide all the advantages of Ozalid printmaking.

ONLY OZALID GIVES YOU THIS VERSATILITY

With Ozalid you're not limited to one-color reproductions. You can make prints having blue, black, or maroon lines on a white background. This allows you to assign identifying colors to different departments, to distinguish checked from unchecked prints, etc.

With Ozalid you can use cut sheets as well as roll stock. By ordering sheets cut to the size of your tracings, you can completely eliminate trimming waste.

With Ozalid you can use a wide selection of foils and transparent materials—an impossibility with other methods. You can employ these to reclaim the details of soiled or worn tracings . . . to make composite prints . . . and duplicate originals to be used instead of the original tracings in subsequent print production.

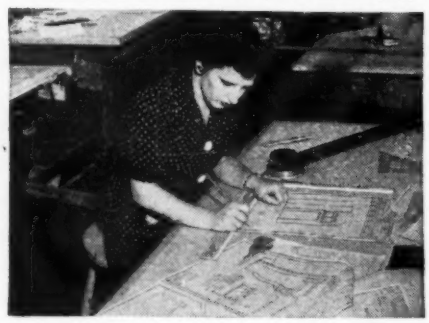
All Ozalid Prints are produced in the same manner. Dry Development eliminates variations in production.

These Ozalid features will give you a "head start" in production.

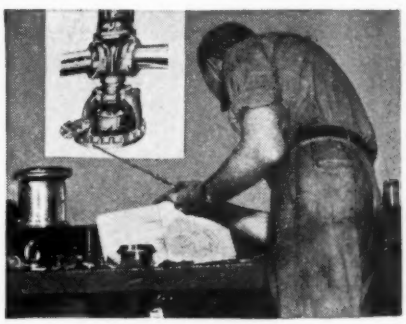
PHOTOGRAPHS—COURTESY OF AMERICAN AIRLINES

1 An Ozalid machine is clean, compact, and may be installed in a corner of the drafting room. Any inexperienced person can operate it. *ALL* prints are produced in the *same* continuous operation which incorporates *Exposure* and *Dry Development.*

No baths, driers, or plumbing connections.



2 When making design changes, it's never necessary for the draftsman to redraw any lines which remain the same. Ozalid saves valuable time. Make a "duplicate original" of the tracing. Then, delete the obsolete sections with Ozalid Correction Fluid — and draw in the new design. It's that easy!



3 Ozalid whiteprints of engineering and isometric drawings enable even inexperienced workers to grasp production details quickly. They are easier to read and check than blueprints and are preferred in the shop and field. Pencil or ink notations can be recognized immediately.

WRITE FOR CATALOG AND SAMPLES OF OZALID WHITEPRINTS

OZALID PRODUCTS DIVISION

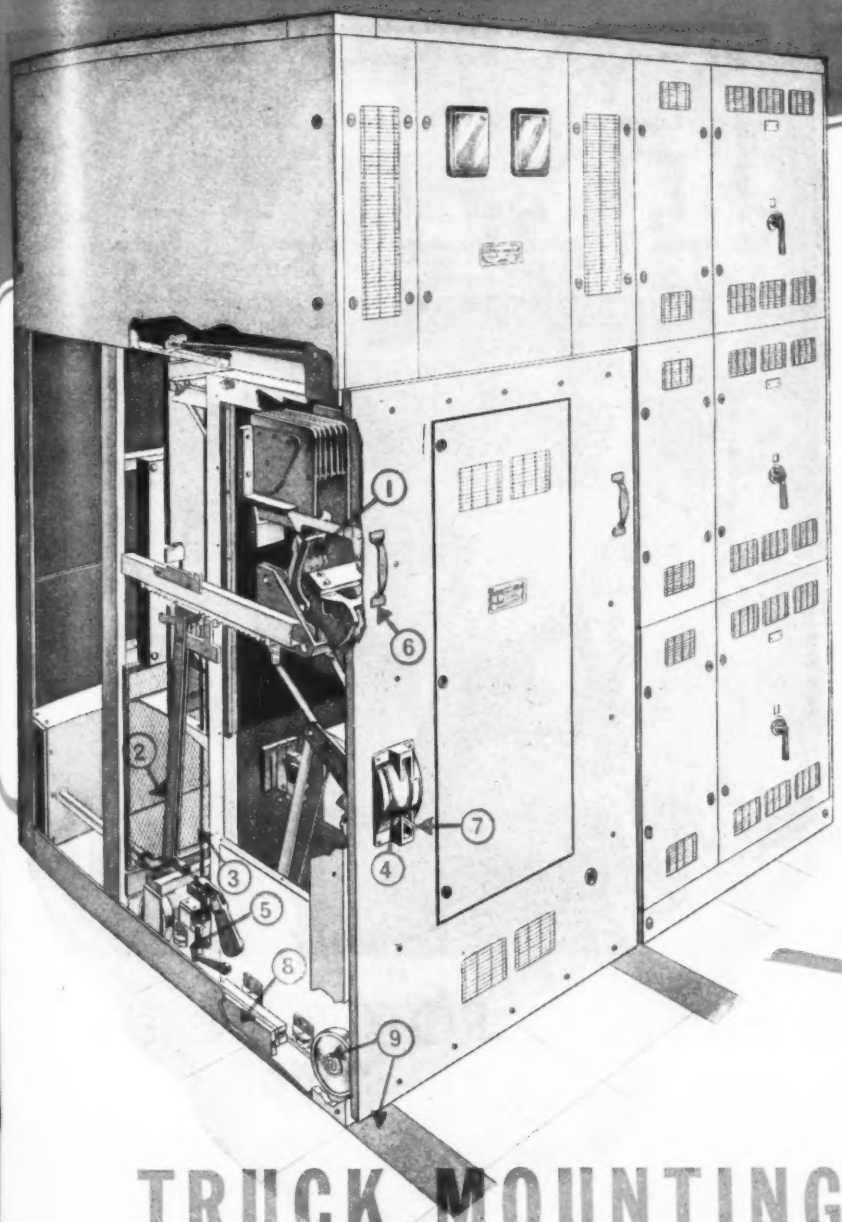
GENERAL ANILINE AND FILM CORPORATION

JOHNSON CITY, N. Y.

OZALID IN CANADA—HUGHES OWENS CO., LTD., MONTREAL

P.S. Some More Ozalid Users:

1. Pratt & Whitney Aircraft Division
2. United States Rubber Company
3. Bethlehem Steel Company
4. Emerson Radio & Phonograph Corp.
5. Ford Motor Company
6. Cramp Shipbuilding Company
7. International Business Machines Corp.
8. Edward G. Budd Manufacturing Co.
9. North American Aviation, Inc.
10. Boeing Aircraft Company



(1) **LARGE AIR CIRCUIT BREAKERS**—All drawout-type breakers, rated 2000 amperes and above, are mounted in trucks for easy handling.

(2) **DRAWOUT MECHANISM**—A simple, built-in mechanism, acting like a ratchet jack, withdraws truck to test position where disconnecting devices no longer restrain it. This mechanism also returns the truck into full contact.

(3) **REVERSING LINKAGE**—Reverses the "bite" of the pawls on the rack to change the direction in which the drawout mechanism moves the truck.

(4) **SOCKET FOR DRAWOUT LEVER**—The lever for operating the drawout mechanism is removed when not in use.

(5) **SAFETY TRIP**—Roller runs on a guide and prevents breaker being closed unless truck is fully inserted; or in test position; or withdrawn. It also trips the breaker if an operator attemps to insert the truck with breaker closed.

(6) **HANDLE FOR DRAWING TRUCK OUT OF HOUSING**—When the truck has been moved to the test position, a pull on this handle releases the connected latch, allowing complete withdrawal.

(7) **TRIP AND REVERSING LINKAGE HANDLE**—Raising this handle trips breaker open. This action also sets reversing linkage in "drawout" position. Pushing handle down moves linkage to "insert" position.

(8) **TRUCK GUIDE**—Guides, one on each side of housing, keep truck straight as it moves in or out.

(9) **RAILS AND WHEELS**—Rails are grouted in the floor flush with the surface. Ball-bearing wheels allow truck to be drawn out with very little effort.

TRUCK MOUNTING DETAILS IN I-T-E DRAWOUT SWITCHGEAR

Features identified above are concerned principally with the action of moving an I-T-E truck-mounted circuit breaker into the board or of drawing it out. There is some engineering to admire in the drawout arrangements for they mean safety to men and equipment and they mean ease of moving a husky assembly. Manufacture must be exact because, in many cases, spare trucks are kept at hand to assure continuity of service during inspection or maintenance periods, and spares must fit and act as neatly and positively as the trucks replaced. Many other features, besides the ones listed here, are standard in I-T-E practice. To have at hand a more complete presentation of them, send for Bulletin 4207—"Multumite Switchgear Assemblies, Drawout Type."

I-T-E

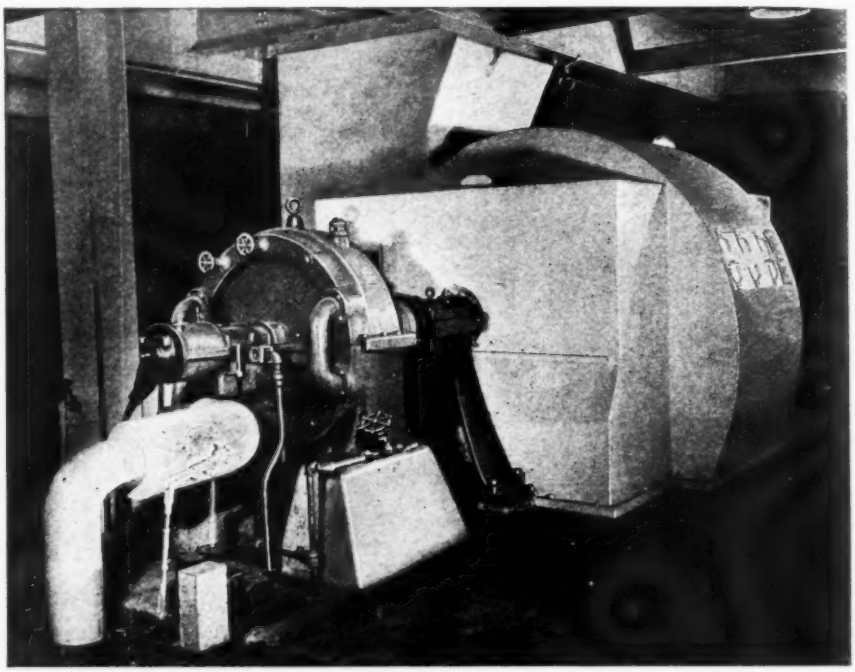
AIR SWITCHGEAR

IMMERSED IN AIR • ENCASED IN STEEL

Representatives in Principal Cities

CIRCUIT BREAKER CO., PHILADELPHIA, PA.

TERRY



BUCKETS AND ROTOR IN THE TERRY WHEEL TURBINE

. . ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

ABOVE: 250 H.P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

A LESSON IN WATER COOLING

LESSON 6 OF A SERIES

WATER SUPPLY PIPING

The supply piping of a water cooling tower is comprised of *inlet* and *distribution* piping.

The inlet piping includes the external supply line and vertical risers that convey the water to the top of the tower and deliver it to the distribution system. The inlet piping is not considered a part of the cooling tower proper and therefore is not customarily furnished with the tower equipment.

The distribution piping is an integral part of the tower and is composed of headers, laterals and the outlets for spreading the water evenly over the tower area above the internal filling. The design and construction of this piping will vary with the manufacture, type and size of tower as well as with the service requirements.

When selecting a cooling tower for a given job the following factors relative to the supply piping should be considered.

1. The number of vertical supply risers and the installation of valves should be such as to provide necessary flexibility and control for proper operation of the cooling tower under all conditions.
2. External vertical risers as well as inlets to the distribution piping should be of such size as to provide normal friction losses.
3. A careful study should be made of the size and length of external supply line alongside of the tower. The shorter this supply line and the fewer the risers, the lower the comparable cost will be.
4. The distribution piping system should be of such design as to permit considerable variation in water quantity circulated without measurably decreasing its effectiveness.
5. The distribution system should be accessible for inspection and cleaning.

PROPERTIES OF STANDARD CLASS "A" C. I. PIPE*

Pipe Size	Outside Diam.	Wall Thickness	Weight per Foot	Int. Area
4	4.84"	.42"	18. lb.	12.56 sq. in.
6	6.88"	.44"	27.9 lb.	28.27 sq. in.
8	8.92"	.46"	38.7 lb.	50.26 sq. in.
10	11.0"	.50"	51.9 lb.	78.54 sq. in.
12	13.08"	.54"	67. lb.	113.10 sq. in.
14	15.14"	.57"	82.3 lb.	153.94 sq. in.
16	17.20"	.60"	98.8 lb.	201.06 sq. in.
18	19.28"	.64"	118.3 lb.	254.47 sq. in.
20	21.34"	.67"	137.4 lb.	314.16 sq. in.
24	25.52"	.76"	136.5 lb.	452.39 sq. in.
30	31.76"	.88"	266.1 lb.	706.86 sq. in.

*From Handbook of Cast Iron Pipe, C. I. Pipe Research Assn.

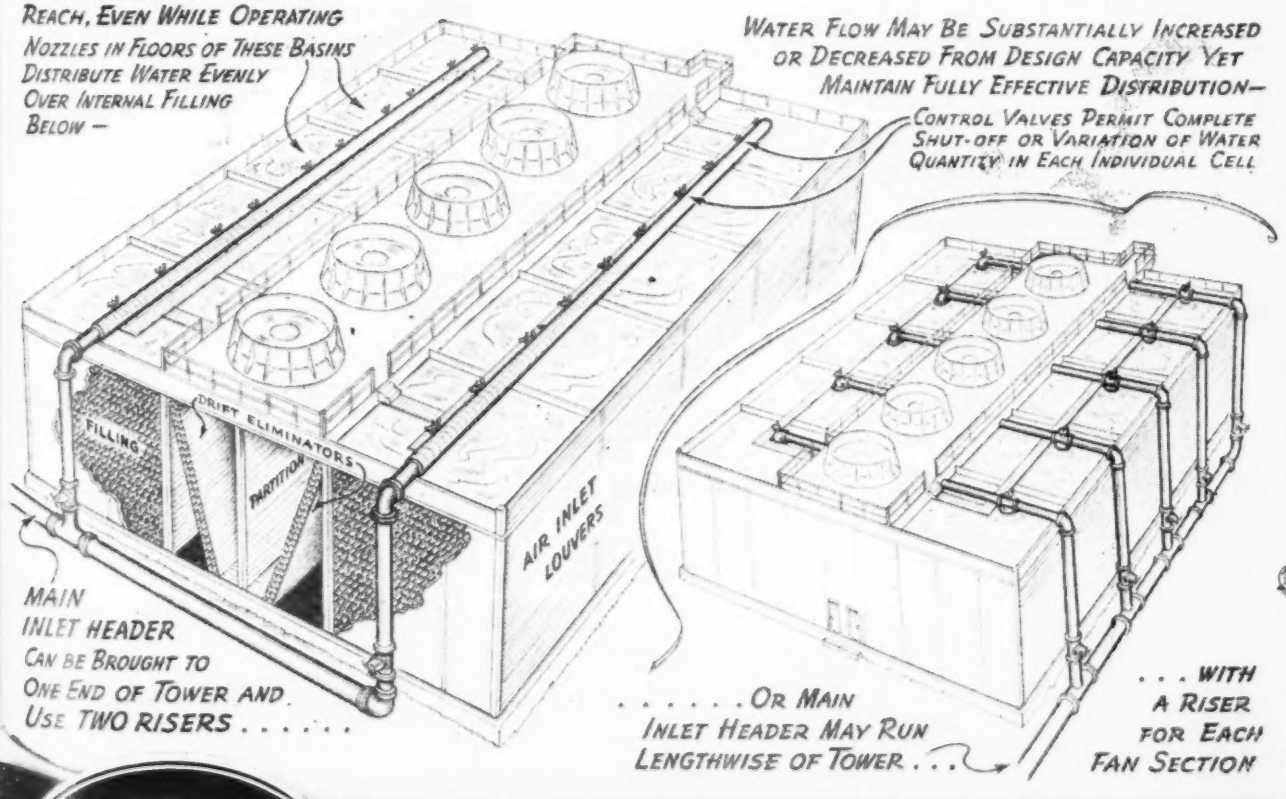
AN EXAMPLE OF GOOD PIPING— THE MARLEY DOUBLE-FLOW COOLING TOWER

ENTIRE DISTRIBUTION SYSTEM OPEN TO VIEW AND EASY TO REACH, EVEN WHILE OPERATING

NOZZLES IN FLOORS OF THESE BASINS DISTRIBUTE WATER EVENLY OVER INTERNAL FILLING BELOW —

WATER FLOW MAY BE SUBSTANTIALLY INCREASED OR DECREASED FROM DESIGN CAPACITY YET MAINTAIN FULLY EFFECTIVE DISTRIBUTION—

CONTROL VALVES PERMIT COMPLETE SHUT-OFF OR VARIATION OF WATER QUANTITY IN EACH INDIVIDUAL CELL



MAIN INLET HEADER CAN BE BROUGHT TO ONE END OF TOWER AND USE TWO RISERS . . . . . .

. . . . . OR MAIN INLET HEADER MAY RUN LENGTHWISE OF TOWER . . .

. . . WITH A RISER FOR EACH FAN SECTION

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC.
KANSAS CITY, KANSAS

83-A

. . . "BUSS Fuses have kept our Cupola Blower Operating without a Needless Shutdown

. . . formerly we had an average of two outages per month,"

Says

ELECTRICAL MAINTENANCE SUPERINTENDENT

KARL MOEHLMAN

of Gisholt Machine Co., Madison, Wisconsin

"From a production standpoint," continues Mr. Moehlman, "probably the most important circuit in our plant is for a 50 horsepower, 220 volt, 3-phase motor operating a cupola blower. This blower simply *must not* fail, otherwise serious production loss occurs, involving damage to critical material.

"This particular circuit was blowing fuses at an average rate of twice a month, until we switched to BUSS Super-Lag fuses more than six months ago. Since the change, not a single fuse has been blown."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible. . . .

and

The **SUPER-LAG** development in the FUSE-LINK completes the job.

BUSS

Can Mr. Moehlman's experience at Gisholt suggest to you a way to eliminate needless production shutdowns due to fuses opening needlessly? His experience is like that of many others who have found that the long time-lag of BUSS Super-Lag fuses prevent needless shutdowns due to harmless overloads. Yet these fuses give you the protection you need when serious trouble occurs.

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Here is why BUSS fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

How to solve the "shutdown" problem

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

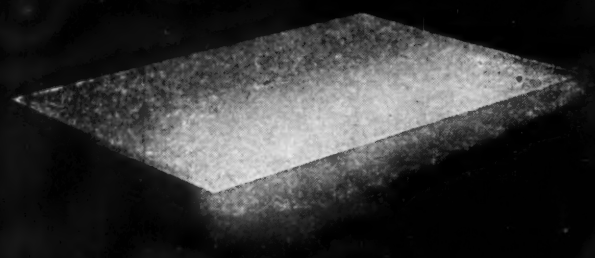
BUSSMANN MFG. CO., University at Jefferson, St. Louis 7, Mo.
Division McGraw Electric Company

Super-Lag FUSES

SOLD THROUGH WHOLESALERS

PROBLEM:

Tempering Steel for Uniform Hardness



SOLUTION: Controlling Rate of Cooling and Final Temperature

• Here is an unusual application of mechanical cooling provided by Carrier for a large manufacturer of all types of heavy industrial knives including planer blades and knives used in the processing of paper. All of today's production must be speeded for war work.

Carrier refrigeration helped to break a "bottleneck" by cooling the solution in the tanks in which the steel knives are quenched. A bright cherry red on entering the tank, the steel is cooled in the solution. The tempering solution is cooled by circulating chilled water through lead coils located in the tanks. Temperature in each of the tanks is controlled by thermostats which operate solenoid valves.

Carrier's experience in cooling fluids for industrial processing dates from the early years of this century. If your plant has a production problem in which control of temperature or humidity or the circulation of cleaned air may be a factor, Carrier can help you. Write today for information.

CARRIER CORPORATION, Syracuse, N. Y.

Carrier

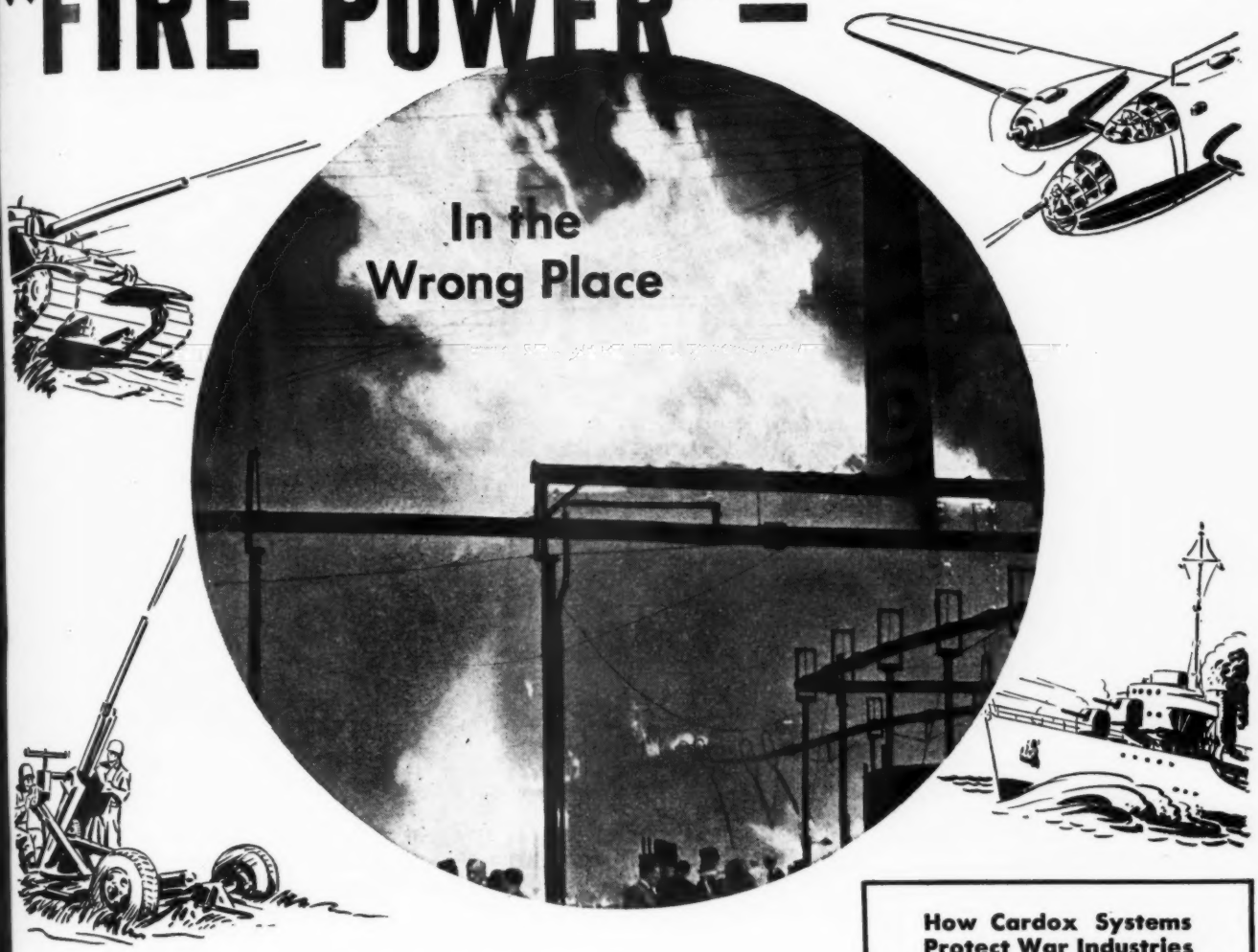
ARMY E NAVY

AIR CONDITIONING • REFRIGERATION

INDUSTRIAL HEATING

FORTY-ONE YEARS EXPERIENCE IN INDUSTRIAL INSTALLATIONS

"FIRE POWER"—



IS A LIABILITY

"Fire Power" is a two-edged force. Applied by our weapons of war, it is driving the enemy nearer and nearer to complete defeat. Generated by combustibles in a vital war plant, "fire power" can cause crippling delays of war production in a dozen other plants.

Cardox Fire Extinguishing Systems are helping assure plenty of *effective* fire power for our fighting forces by guarding against *destructive* fire power in plants producing such critical war products as:

Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel, Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.

An extremely wide variety of indoor and outdoor hazards—large or small—can be efficiently protected by individually engineered Cardox Fire Extinguishing Systems. By instant smothering of fire and cooling of combustibles through mass discharge of low pressure, low temperature carbon dioxide, they provide the all-important advantages of fast, complete extinguishment . . . *without damage to plant and equipment by the extinguishing medium.*

Today Cardox is concentrating on (1) Fire Extinguishing Systems needed to insure more effective "fire power" for our Armed Forces; (2) plans to increase the efficiency of fire protection, both today and after the war.

If you would like more information, write on company letterhead for Bulletin 9113.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in **New York • Washington Detroit • Cleveland • Atlanta • Pittsburgh San Francisco • Los Angeles • Seattle**

How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

"KNOW HOW!

TO GET THE MOST OUT OF YOUR *Packings*"

With materials shortages, the Packing Industry faces a difficult task—to supply Industry with packings so vital in our War Effort. Naturally this is being done, but not without difficulties promoted by present conditions.

Under these circumstances, knowing how to get the most out of your packings takes on new importance. Through proper packing, conserved wisely, machines can be kept running efficiently at less cost. 'Know How' simplifies packing difficulties; points the ways and means to conserve vital packings; and, reduces packings problems to a minimum.

To help you get the most out of your packings, Belmont Packings, as a service to you, suggest below ways to make your packings last longer:—

1. **CONSERVE PACKINGS**—When repacking, it may be found that a few rings of new packing inserted next to the gland may give added service. This will mean conservation of old packing retained in the stuffing box.

2. **LUBRICATE MOVING PARTS**—Keep rods, shafts and plungers thoroughly swabbed with oil or grease to alleviate frictional wear on packing. Where practicable, install oil lanterns.

3. **CHOOSE SUBSTITUTE CONSTRUCTIONS**—When material shortages make your desired type not instantly available, consult with your nearest Belmont distributor or with us for guidance on this question.

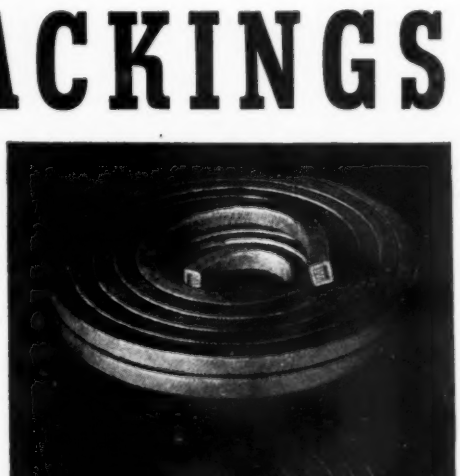
4. **REFER TO THE BELMONT CATALOG**—It's an invaluable packing guide of complete information on packings for all services... it contains informative charts; clearly illustrates and describes every Belmont packing; and suggests varied packing styles from which to choose a substitute packing, if necessary. Write on your Company letterhead for your copy.

BELMONT PACKINGS

The Belmont Packing & Rubber Co.

Butler and Sepviva Sts., Philadelphia 37, Pa.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.



There's a Belmont Packing for every service... Steam, Water, Oil, Gas, Air, Acid, Alkalis, and Ammonia. Forms include Rings, Coils, Spirals, Reels, Spools, Sheets, and Gaskets.

ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINATORS

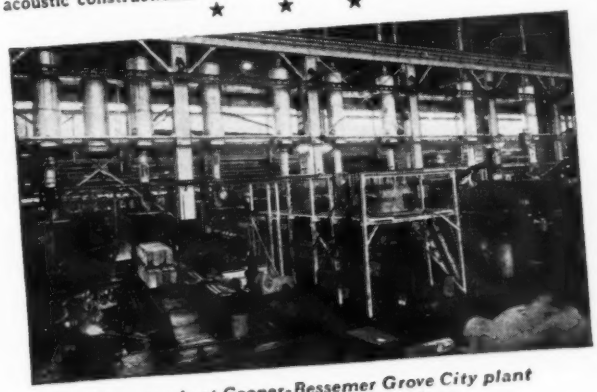
BURGESS SNUBBER BULLETIN on Diesel Exhaust Noise Control

Burgess Snubbers in the War

The Snubber Bulletins which appear on this page have not often shown naval vessels, army power plants, or other direct war applications. Photographs of such installations are usually difficult or impossible to obtain under the necessity for wartime secrecy, but it is possible to show some of these units, most of them developed to meet a specific need of the Army or Navy.

The picture at the right shows a number of Burgess products designed for special service since the beginning of hostilities. Most of these are intake silencers; the four units across the bottom of the picture being the only exhaust units shown. The exhaust units are engineered on the well-known Burgess snubbing principle, while the intake units generally utilize other patented Burgess acoustic constructions.

★ ★ ★



Test stands at Cooper-Bessemer Grove City plant equipped with Burgess Snubbers.

QUIETING TEST STANDS' EXHAUSTS

Engine manufacturers with large numbers of engines running on test simultaneously have an unusually difficult problem of exhaust noise quieting. In one plant draftsmen were forced to work in a constant roar of noise because engines were exhausted into an areaway below them, and the mufflers used did not provide sufficient quieting. The installation of a row of Burgess Snubbers on these engines solved the problem.

The difficulty of controlling exhaust noise on test stands is complicated by the fact that flexible couplings and other temporary hook-ups mean that a set exhaust pipe length cannot be maintained for every engine under test. Therefore, old-style exhaust mufflers often vary greatly in the degree of silencing which they provide.

One of the requirements of exhaust quieting devices on these test stands is that they must not in any way impair the operating efficiency of the engine. If efficiency were interfered with, the engine would not be undergoing a fair test.

It is significant, therefore, that a great many engine manufacturers have equipped their engine test stands with Burgess Exhaust Snubbers. The Cooper-Bessemer Corporation, Waukesha, Hamilton, Buda, General Motors, Fairbanks-Morse, and many other engine manufacturers have installed Burgess Snubbers on their test stand exhausts.

This is another example of the way in which Burgess Snubbers have been able to meet stringent requirements for quiet, because they can be installed without regard to exhaust pipe length or location.

★ ★ ★

MINE SWEEPER The YMS-241 is one of twelve mine sweepers being built by the Tacoma Boatbuilding Company. It will be used to clear safe channels through mine fields for larger and more heavily armored craft.

Burgess Exhaust Snubbers and Intake Silencers are used on these boats, as well as a Burgess Acousti-Booth in the engine room.

Published by ACOUSTIC DIVISION, BURGESS BATTERY COMPANY — 2823-L W. Roscoe St., Chicago 18, U.S.A.

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ORIGINATORS OF SNUBBING PRINCIPLE FOR QUIETING DIESEL EXHAUSTS—BURGESS—ORIGINATORS
COMPLETE SATISFACTION IN EXHAUST AND INTAKE QUIETING—SPECIFY BURGESS SNUBBERS—FOR COMPLETE

IT CAN'T HAPPEN HERE!

BREAK-THROUGH is virtually impossible in a Badger Self-Equalizing Expansion Joint.

To begin with, the exclusive *ALL-CURVE* corrugations of this carefully engineered joint distribute and absorb *evenly* the normal stresses caused by expansion and contraction. . . . There is no tendency of stresses to localize, as is the case with corrugations having straight sides, angles or "junctions."

But the Badger advantages do not stop here. . . . The Badger corrugations have the *extra support* of specially designed Badger *ALL-CURVE* Equalizing Rings. These rings not only control or direct the flexing, but keep it within prescribed limits. When temperature and pressure become high, the Equalizing Rings "close ranks"—stand shoulder-to-shoulder to form a solid wall of reinforcement.* They provide a margin of safety far beyond maximum requirements, and also assure long metal life by guarding against excessive flexing movement.

• • •

• ***Directed Flexing—ALL-CURVE Corrugations—Packless Design—One-piece Construction*** of corrugated member (from a single piece of Copper or Stainless Steel tubing)—*Special Methods of Forming and Heat-treating* . . . read about these and other Badger Corrugated Expansion Joint features in our FREE BULLETIN No. 100.

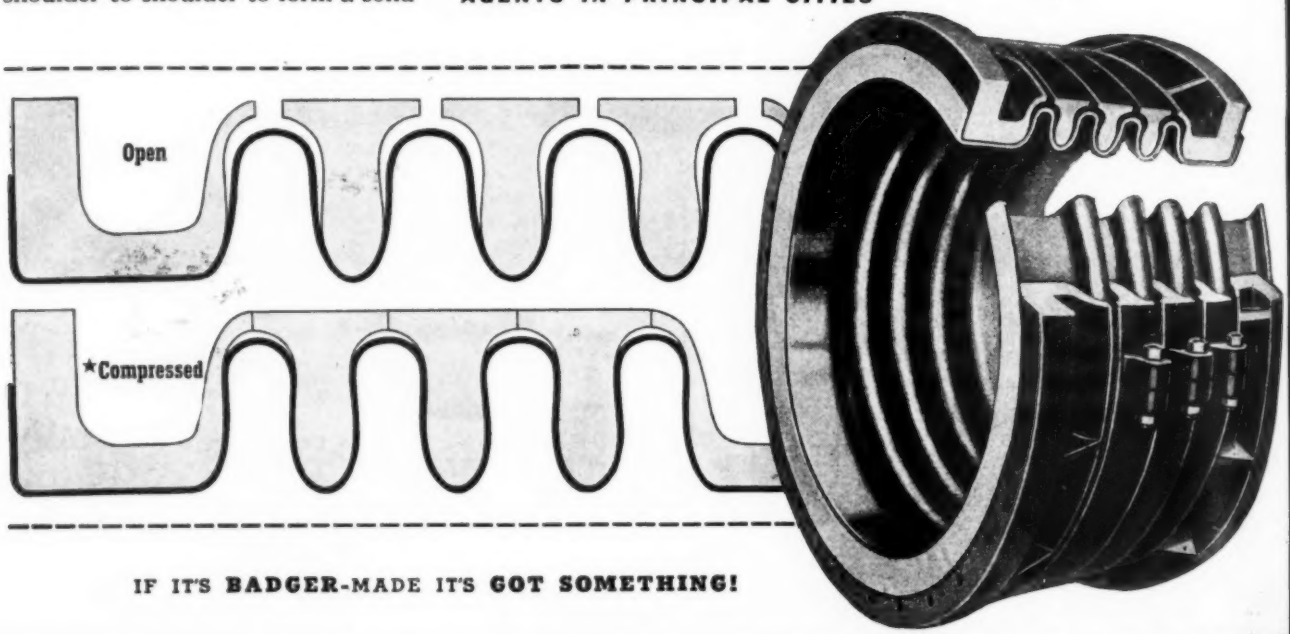
• • •

BADGER SELF-EQUALIZING EXPANSION JOINT *(illustrated)*—Made of either Copper or Stainless Steel for longer traverses and high pressures. *Non-Equalizing (packless)* type—without rings also available for pressures up to 25 pounds and traverses not exceeding ½".

E. B. Badger & SONS CO.

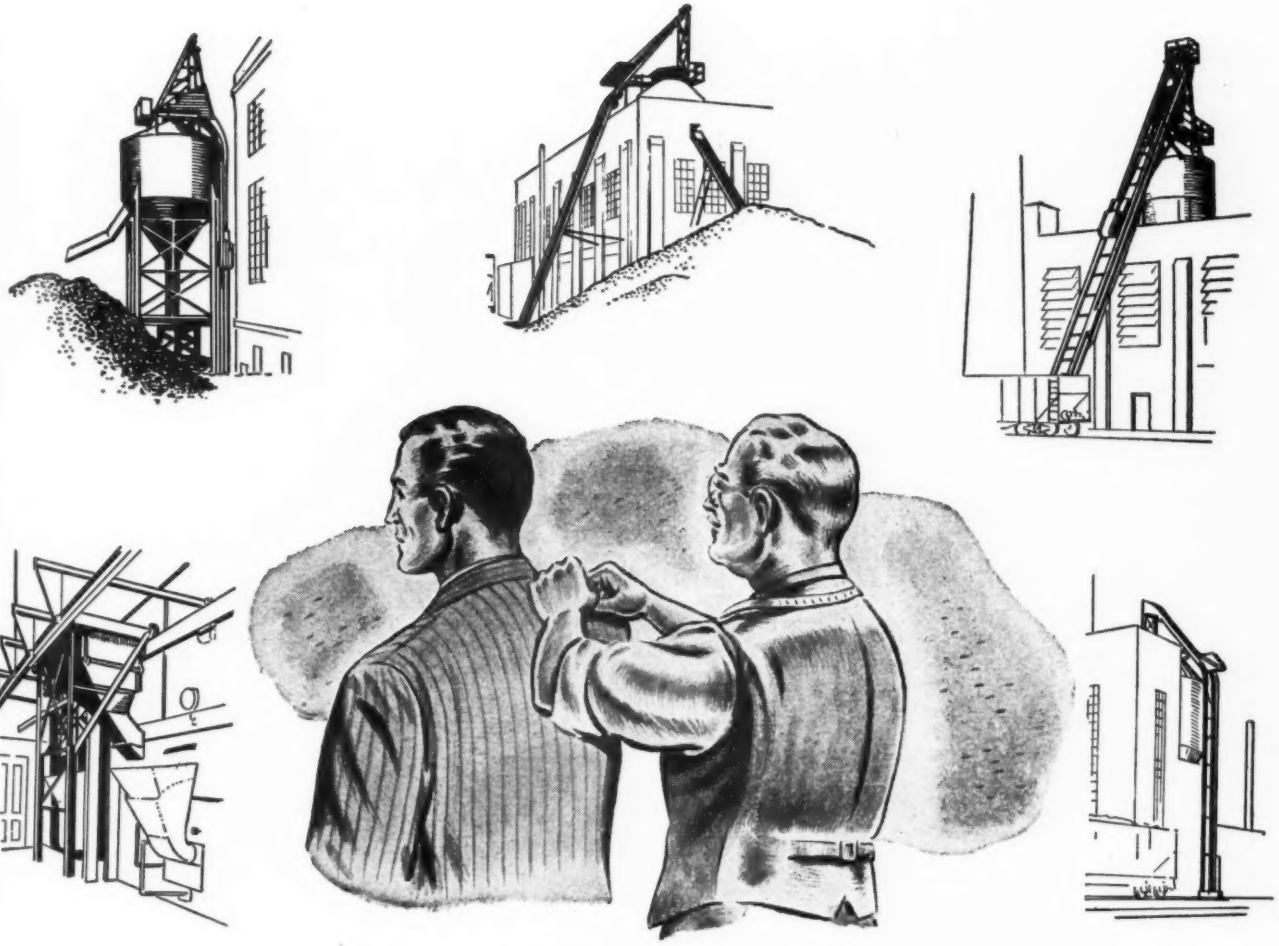
75 PITTS STREET, BOSTON, MASS.

AGENTS IN PRINCIPAL CITIES



IF IT'S **BADGER**-MADE IT'S **GOT SOMETHING!**

BADGER CORRUGATED EXPANSION JOINTS



Fitted Exactly...

to your particular yard and building requirements

● Like the tailor in your favorite department store,— Bartlett-Snow engineers can give you all the advantages of "made-to-order" coal handling at "ready-to-wear" *price* and *delivery*.

You see,— we've studied scores of our most outstanding installations, taken the best ideas from these "best" jobs—and—with more than 40 years experience in this work, developed, and completely engineered, a group of "ideal" coal handling arrangements for different sizes and types of large, medium and small size power and boiler plants.

Each of these systems represents an actual installation of proven fitness for that size and type of plant. Like the suit they can be altered easily, to meet a variety of yard and building requirements. They combine maximum dependability, with low maintenance and low operating costs. They involve a minimum of "starting-up" adjustments—and—because the major design and engineering work has already been completed, they minimize the charges for new engineering — save the purchaser money!

A letter for more details involves no obligation, or, send for a copy of our Bulletin No. 83. It contains much information of interest to every works manager, engineer, or power plant superintendent.— Coal Handling Department —The C. O. Bartlett & Snow Company—6205 Harvard Avenue, Cleveland, Ohio.

BARTLETT-SNOW COAL HANDLING

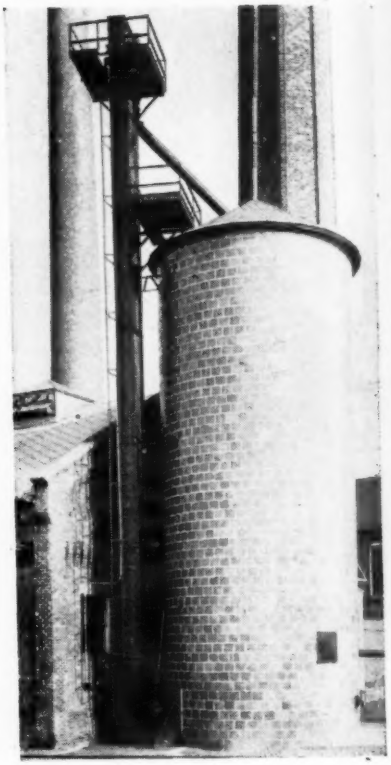
CENTRAL STATIONS and INDUSTRIAL BOILER PLANTS

TRACK HOPPERS • SKIP HOISTS • BUCKET ELEVATORS • BELT CONVEYORS
BINS AND BUNKERS • WEIGH LARRIES • FIELD STORAGE • ASH HANDLING

Convert your Plant to Coal THE MODERN WAY • • •

In view of the increased shortage of fuel oil, due to the vast quantities being diverted to speed-up our war activities, many plants have already converted their plants to coal.

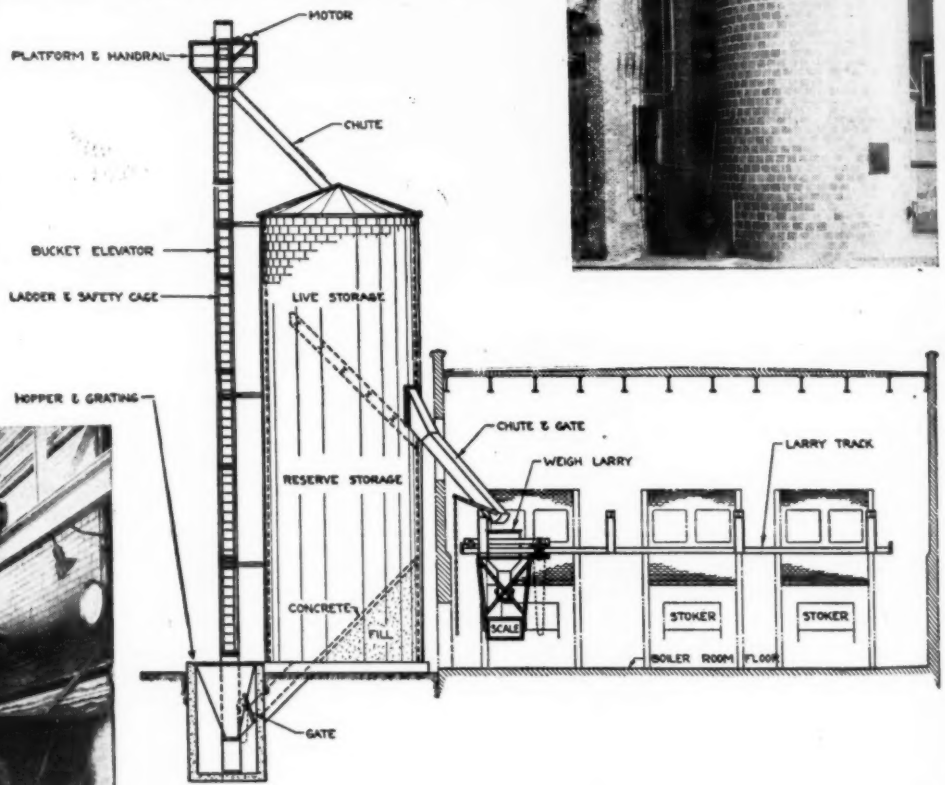
If you are now considering this change-over—if you have space limitations—if you want a system that will fit in with your present structure—it will pay you to install

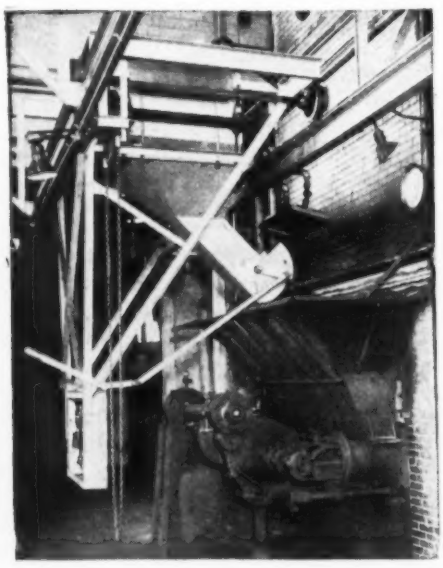


FAIRFIELD SILO SYSTEM

Fairfield provides a complete system for the handling and storage of coal—from car to silo to stokers or pulverizers—all automatic.

The Silos can be furnished in capacities from 100 to 500 tons depending upon diameter of silo—12 to 24 feet. Made of vitrified tile they do not use critical materials needed for the war. Being located outside of boiler house and requiring very little space they do not interfere with light and ventilation, and eliminate dust in the boiler house.



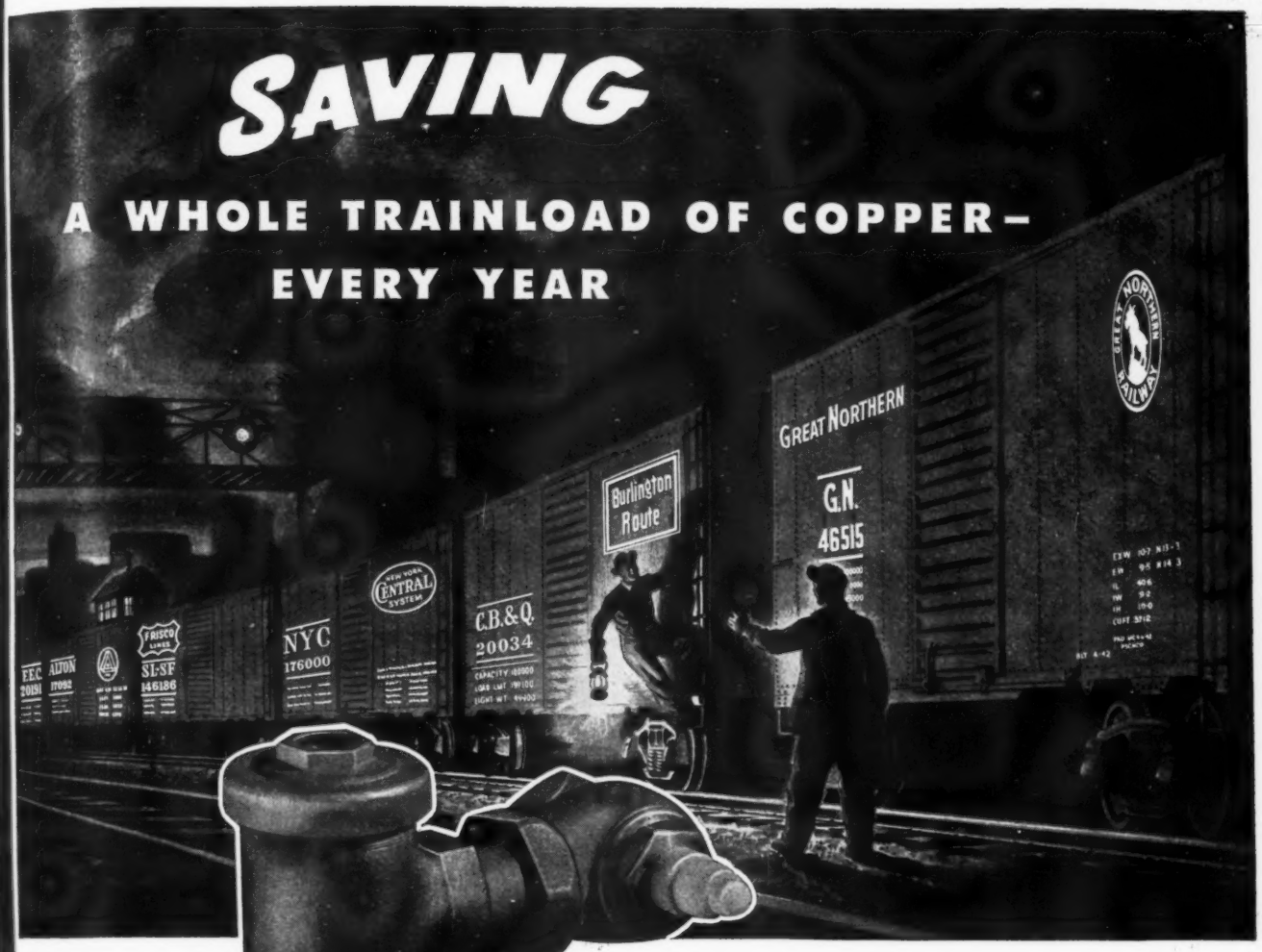


Our catalog shows numerous Fairfield installations and plan drawings of each. Write for one—look it over—we'll be glad to have one of our engineers call and discuss the application of a Fairfield Silo System for your plant.

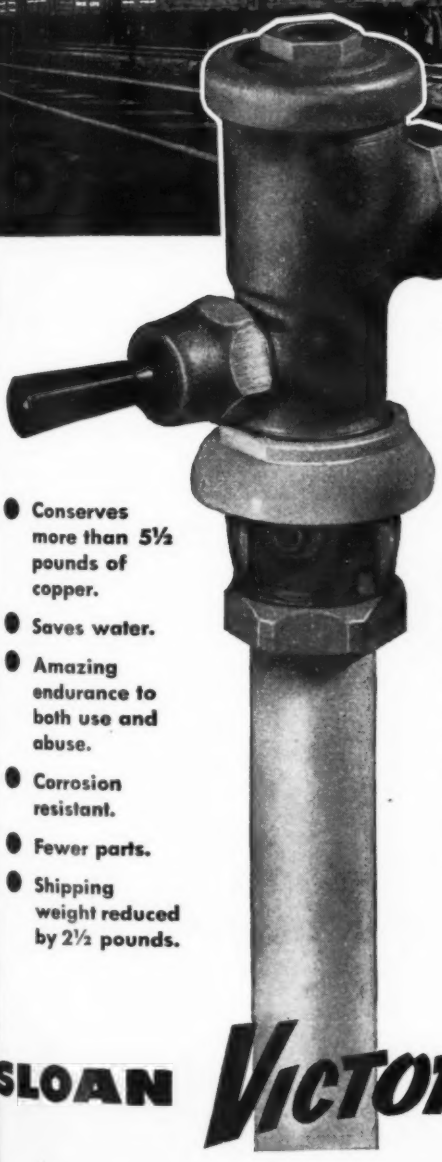
THE FAIRFIELD ENGINEERING CO.- MARION, OHIO
BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

SAVING

A WHOLE TRAINLOAD OF COPPER— EVERY YEAR



Fifty freight cars, each carrying 80,000 pounds, approximates the amount of copper being saved annually* by the new Sloan VICTORY Flush Valve



- **Conserves more than 5½ pounds of copper.**
- **Saves water.**
- **Amazing endurance to both use and abuse.**
- **Corrosion resistant.**
- **Fewer parts.**
- **Shipping weight reduced by 2½ pounds.**

Here is the Valve that *really* saves critical material. More than 5½ pounds of copper per valve is now diverted to direct war uses.

This amazing reduction in the use of precious copper was brought about through the use of malleable iron and plastics for component parts of the Valve. All malleable iron parts are attractively finished with a baked-on protective coating both inside and out—and a plastic sleeve now lines the iron body to provide a smooth, wear-resisting surface for the moving parts.

While the Sloan VICTORY Vacuum Breaker is all-plastic, no change was made in the functional design of the original Sloan V-100-A which was the first vacuum breaker to be approved by the N.A.M.P. Its outer shell, now of transparent plastic, permits *visual inspection*, thus assuring the ultimate in protection against back-syphonage.

In the new VICTORY Valve, the Sloan Valve Company has applied its every resource to produce a high quality flush valve and vacuum breaker which, in cooperation with the War program, uses the irreducible amount of precious copper.

Remember: it is patriotic to specify Sloan—the flush valve that uses the least amount of critical metal.

*(*based on 1942 production figures*)

SLOAN VALVE COMPANY
4300 West Lake Street, Chicago, Illinois

SLOAN VICTORY TYPE FLUSH VALVES

● *The magnitude of the War Department Pentagon Project at Arlington, Va., is best visualized by such facts as: provides working quarters for 40,000 employees; has nearly nine miles of corridors; has six large cafeterias.*

Chief Architects: George E. Bergstrom and David J. Witmer.
Consulting Engineer: Charles S. Leopold.
Plumbing Contractor: Fred Brutschy Co., Inc.

WAR DEPARTMENT'S NEW PENTAGON BUILDING

World's Largest Office Building Installs WATROUS FLUSH VALVES

3,004 Watrous Flush Valves will bring to the new War Department Pentagon Building the "all-out" water and maintenance saving performance for which Watrous Valves are famous. Here in the world's largest office building these valves will demonstrate the tremendous extra savings that are possible when each valve can be *adjusted* to the actual water requirements of the fixture on which it is installed.

For detailed information on the new "V" model Watrous Flush Valve, which is now available for essential applications, write for Bulletin No. 858-W.

THE IMPERIAL BRASS MFG. CO., 514 South Racine Ave., Chicago, Ill.

● *3,004 Watrous Majestic Flush Valves are installed in the Pentagon Building as shown in these two views.*

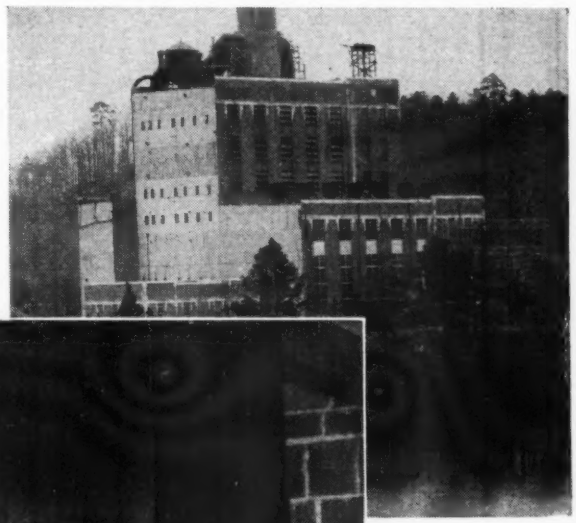
Watrous Flush Valves

ALABAMA POWER COMPANY BUYS A SECOND AMERICAN CRUSHER ...for Low Cost Coal Sizing

HIGHLY satisfactory operating experience with the first crusher installed back in June, 1929, guided the Alabama Power Company's engineers in selecting a second AMERICAN Type 38-S Crusher when load conditions at the Gorgas, Alabama, plant called for more coal crushing capacity.

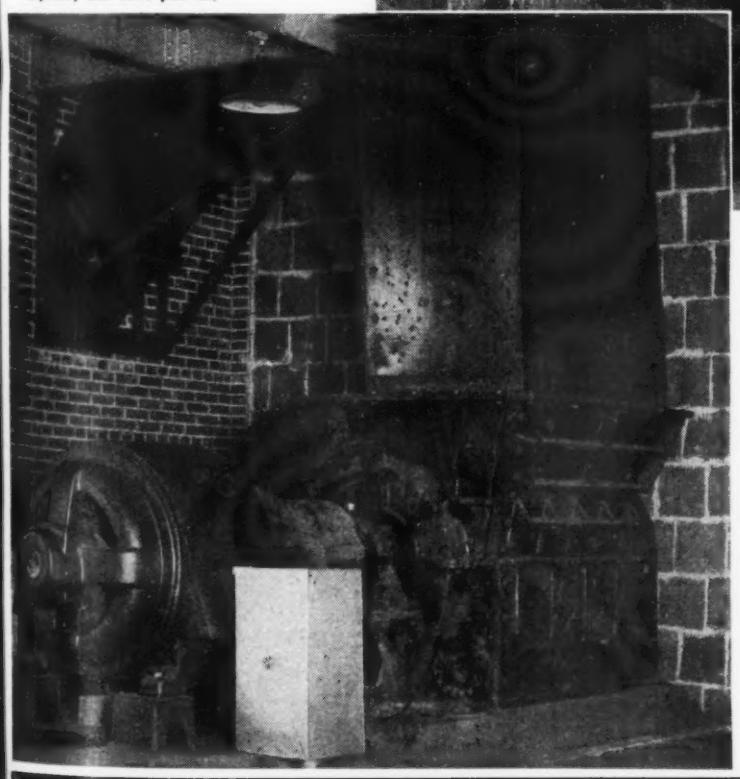
According to the report the total cost of maintenance on the initial AMERICAN Crusher over a service period of 14 years at this plant was less than $2000.

The money saving experience of this busy utility plant is being duplicated in scores of industrial plants and central stations where AMERICAN Crushers—used in either stoker or pulverized coal burning—are reducing total fuel costs from 2½ to 8%.



Above: View of Gorgas Steam Plant of Alabama Power Company.

Below: Original American Type 38-S Crusher installed at Gorgas plant; capacity 200 tons per hr.



AMERICAN Rolling Ring Crushers differ from other centrifugal crushers in that their housings are heavy steel castings, reinforced with ribs making them unbreakable from any crushing strain. Material to be crushed is struck by rings in suspension which shatter and distribute the coal before it reaches the breaker and grinding plate. By a simple adjustment of the patented grinding plate (made of manganese steel to insure long wear) run-of-mine or lump size is reduced to proper size in one operation.

AMERICAN Ring Crushers have capacities of 25 to 500 tons per hour, are built special for each installation and guaranteed for definite performance. Let AMERICAN Crusher engineers cooperate in getting better coal sizing and lower steam costs in your plant.

Write For Free Data Book On Coal Sizing

AMERICAN PULVERIZER COMPANY 1349 MACKLIND AVENUE ST. LOUIS, MISSOURI

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

MAKE ONE BEARING OUTLIVE TWO!

One plant that regularly had two or three bearing failures a month writes us, "We have had only one bearing failure in five years since using LUBRIPLATE"... another writes, "Pulled our ball bearing temperatures down from 170° to 130°F"... still another, "If LUBRIPLATE cost $1.50 a pound we could still afford to use it."

BALL BEARING LUBRIPLATE

Over a period of years this outstanding grease type lubricant has reflected superior performance on the general run of ball and roller bearings operating under normal conditions at speeds up to 5,000 R. P. M. and temperatures from zero to 300 degrees F.

Long time users of BALL BEARING LUBRIPLATE everywhere attest to its superiority in providing cool and quiet operation – protection against corrosion, and of major importance, substantial reduction in bearing replacement costs.

Write today for your copy of Bulletin No. 1-43 containing valuable data on the lubrication and care of anti-friction bearings.

7 FACTS ABOUT LUBRIPLATE

1. *LUBRIPLATE produces an ultra-smooth, wear-resisting bearing surface.* 2. *LUBRIPLATE reduces friction, thus lowering maintenance and power costs.* 3. *LUBRIPLATE resists rust, corrosion and pitting.* 4. *Most LUBRIPLATE products are white. LUBRIPLATE assures clean lubrication.* 5. *LUBRIPLATE outlasts ordinary lubricants many times.* 6. *LUBRIPLATE is economical—a little goes a long way.* 7. *LUBRIPLATE is available in fluid and grease types for every need.*

LUBRIPLATE DIVISION
FISKE BROTHERS REFINING COMPANY
Newark, N. J. SINCE 1870 Toledo, Ohio
DEALERS FROM COAST TO COAST

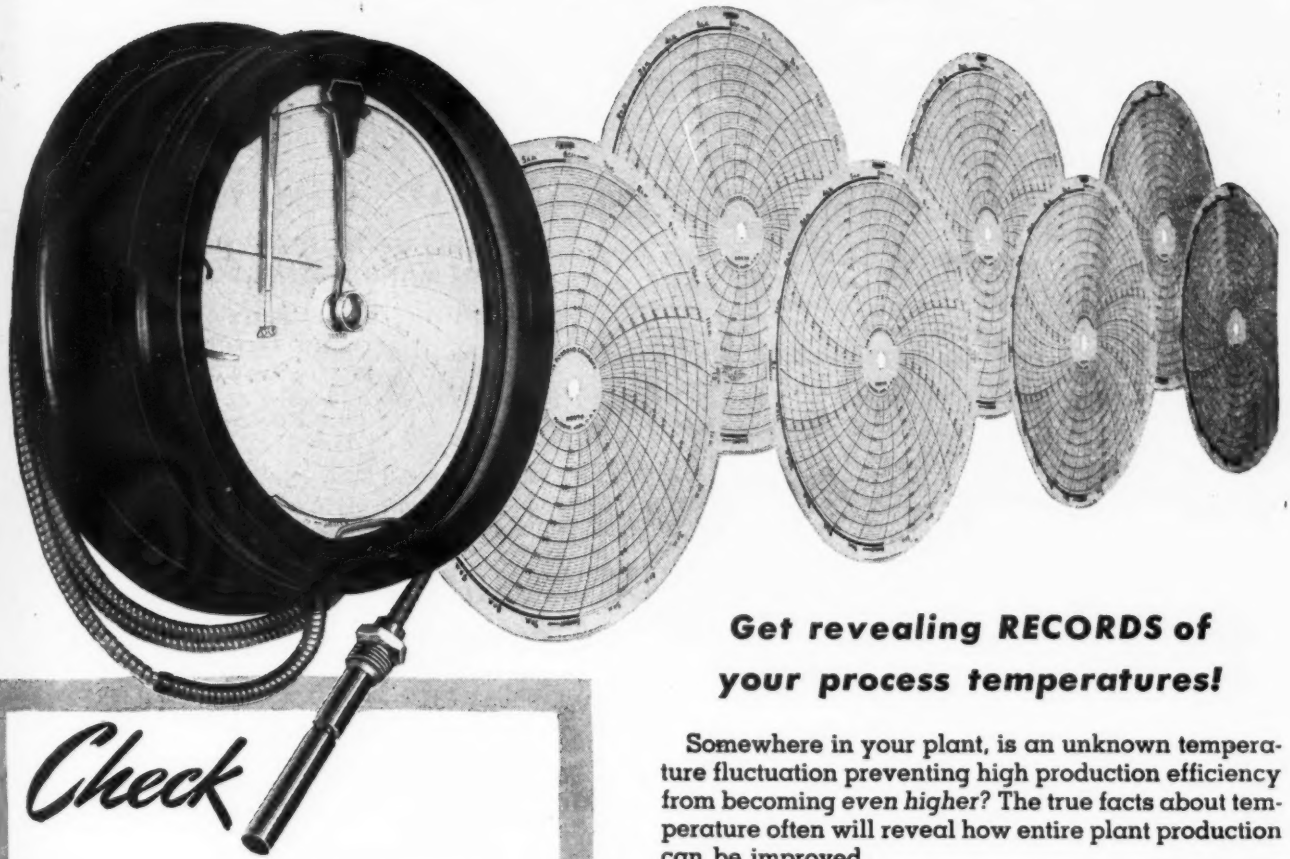
LUBRIPLATE

"Its the Film"

THE MODERN LUBRICANT *that Arrests Progressive wear*

LEARN HIDDEN FACTS

about Your Production!



Get revealing RECORDS of your process temperatures!

Somewhere in your plant, is an unknown temperature fluctuation preventing high production efficiency from becoming *even higher*? The true facts about temperature often will reveal how entire plant production can be improved.

Get these important facts, continuously and inexpensively, by installing automatic temperature recorders at every critical point. *Get them accurately and dependably* by specifying Foxboro Temperature Recorders!

Foxboro Temperature Recorders are precision-engineered to meet toughest industrial needs for accuracy, endurance and trouble-freedom. Their ultra-sensitive thermal system reacts instantly to slightest temperature changes. Their light, strong recording mechanism "writes it down", day-in day-out for years, without attention except routine chart replacements!

Write for Bulletin 198-2 containing the full story of these automatic watchmen for your temperature operations. The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U. S. A. Branches in principal cities of United States and Canada.

Check

THESE APPLICATIONS

Here are just a few of the temperature points where Foxboro Recorders can give you valuable "inside" facts:

ATMOSPHERIC TEMPERATURES
BOILER BLOWDOWN
BOILER MAKEUP
BUNKER OIL STORAGE
ECONOMIZERS
FEED WATER LINES
FLUE GAS
HEAT EXCHANGERS
HOT WATER LINES
SUPERHEATERS
DESUPERHEATERS

FOXBORO
REG. U. S. PAT. OFF.
TEMPERATURE RECORDERS

Too vital to be overlooked

By *any* Power Plant Engineer

THIS UP-TO-THE-MINUTE 24-PAGE MANUAL ON COOLERS FOR

LUBRICATING OIL
- Engines
- Gears
- Turbines
- Machine Tools

OIL PUMP SYSTEMS

TRANSFORMER OIL

ENGINE JACKET WATER

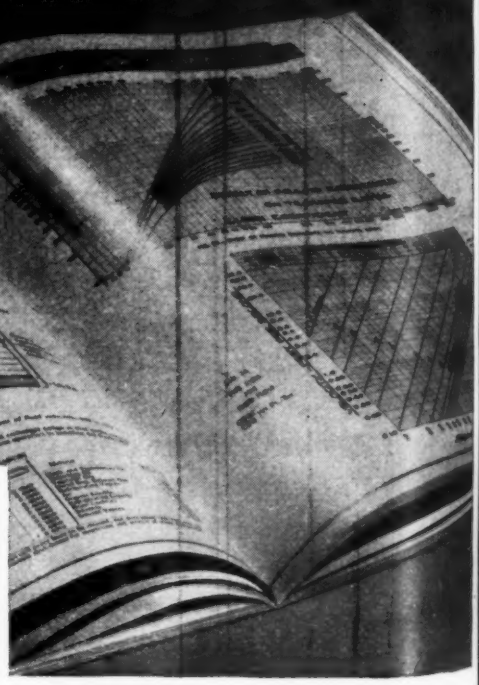
SMALL VAPOR CONDENSERS

and wherever oil, water or other liquids are circulated for heat removal

You'll keep this informative manual on your desk for frequent reference to its practical, helpful data and illustrations IN YOUR WAR PRODUCTION AND POST WAR PLANS.

CONTENTS INCLUDE: Special assemblies for individual conditions; shortcuts to cleaning and inspection; useful performance data, formulae, curves; maintenance of continuous performance; avoiding stagnant areas; special baffle arrangements; flexible mounting, vent and drain provisions; diversified nozzle arrangements; proper selection of materials and many other vital subjects for constant reference.

REQUEST YOUR **FREE** COPY OF MANUAL 5322



ROSS HEATER & MFG. CO., Inc.

Division of AMERICAN Radiator and "Standard" Sanitary Corporation

GENERAL OFFICES AND PLANT

1415 WEST AVENUE **BUFFALO 13, N. Y.**

fireye Prevents Explosions

TYPE F28C

GUARDS AGAINST FLAME FAILURE PHOTOELECTRICALLY

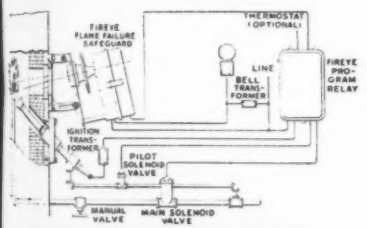
Monitors oil, gas, pulverized coal burners *electronically*. Instantly detects flame failure, cuts off fuel supply.

Controls Every Flame—positively observes even blue transparent gas pilot flame—is the *only* photoelectric safeguard sufficiently sensitive for use with all fuels and for monitoring pilot, main flame, or both.

Acts Instantly, Dependably—is the only control that detects flame failure entirely by direct observation of the flame itself. All other control methods rely wholly or partly on temperature, electrical conductivity or other indirect and, therefore, less positive flame characteristics.

Provides Completely Automatic Control—is used alone for control of manually ignited burners, to turn off both main and pilot valves and sound an alarm; or, when burner is automatically fired with Program Relay Type R25, to provide desired sequence of fuel pump and valve operation.

For complete information, write today for Catalog 50



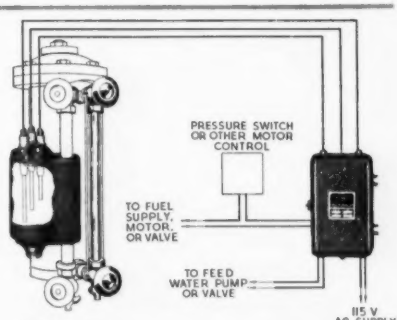
TYPICAL FIREYE INSTALLATION FOR AUTOMATICALLY IGNITED OIL BURNER

fireye BOILER FEEDWATER CONTROL

Floatless . . . Maintenance-Free . . . Electronic

- Maintains Desired Water Level Automatically.
- Instantly Cuts Off Fuel Supply and Sounds Alarm at Low-Water Danger Point.
- Fireye Boiler Feedwater Control operates electronically, contains no moving parts to wear out or fail in operation, is simple to install—at last makes available to the average power plant completely automatic control—at low cost.

Write today for Catalog 51


PRESSURE SWITCH OR OTHER MOTOR CONTROL
TO FUEL SUPPLY, MOTOR, OR VALVE
TO FEED WATER PUMP OR VALVE
115 V. AC SUPPLY
Probe Fitting
Electronic Control

Typical FIREYE Installation For Automatic Boiler Feedwater Control And Low-Level Safeguard

fireye

COMBUSTION CONTROL CORPORATION

77 Broadway, Cambridge 42, Massachusetts

DISTRICT OFFICES IN ALL PRINCIPAL CITIES

MORE Power TO FT. WAYNE!

Carey HEAT INSULATIONS

Selected FOR NEW POWER PLANT OF INDIANA SERVICE CORPORATION

The Ft. Wayne area is today one of the nation's leading centers of industrial activity. To meet the greatly increased demand for power, industrial and domestic, the Indiana Service Corporation found it necessary to erect a new, thoroughly modern plant of high production efficiency.

Use of Carey Hi-Temp and 85 % Magnesia Heat Insulations on the pipes and equipment of this plant—as well as its use by many other large utilities the country over—is significant of the nationwide Carey reputation for quality and dependability.

Tough, durable Carey Heat Insulations insure high efficiency . . . reduce fuel consumption to a minimum . . . make possible highest kilowatt output at lowest cost. . .

Boiler in modern power plant of Indiana Service Corporation, Ft. Wayne, Ind. Carey Heat Insulation applied by Asbestos Insulation & Roofing Co., Ft. Wayne.

Whatever your insulation problems, you'll find the answer in Carey Heat Insulations. For complete information, write Dept. 16.

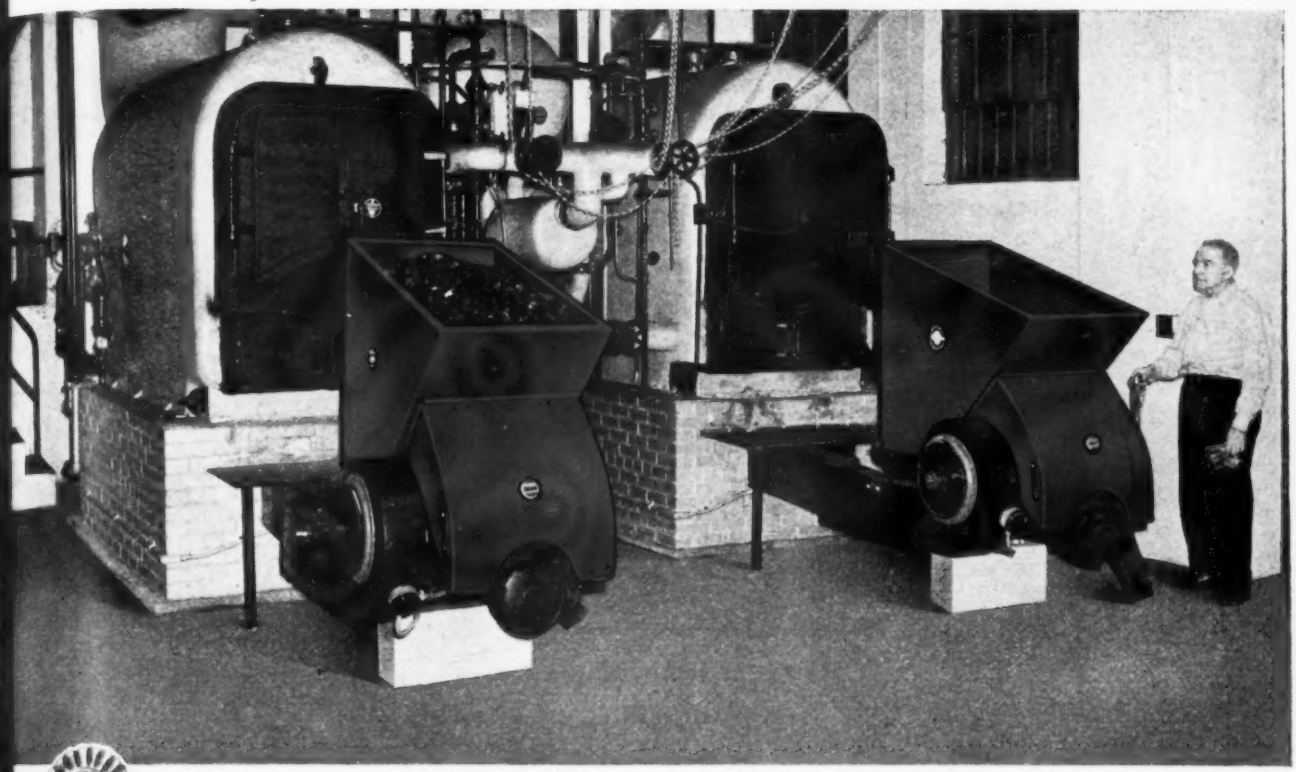
THE PHILIP CAREY MFG. COMPANY

Dependable Products Since 1873

Lackland CINCINNATI, OHIO

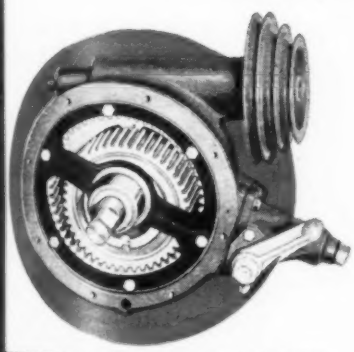
IN CANADA: THE PHILIP CAREY COMPANY, LTD. • • OFFICE AND FACTORY: LENNOXVILLE, P. Q.

THEY'VE LICKED THE FUEL OIL PROBLEM WITH *WINKLER STOKERS*



THE ROLL CALL OF WINKLER STOKER USERS READS LIKE A BLUE RIBBON LIST OF AMERICAN INDUSTRY. A FEW ARE:

Allis-Chalmers Company • New York Life Insurance Company • Coca-Cola Bottling Co. Firestone Tire & Rubber Company • American Air Lines • Koppers Coal Company • Pepsi-Cola Bottling Company • Curtiss-Wright Corporation • P. Lorillard Company • U. S. Navy U. S. Army • U. S. Army Air Corps • U. S. Department of Agriculture • Bell Telephone Company • Owens-Illinois Glass Company • Cadillac Division of General Motors • National Gypsum Company • Douglas (Aircraft) • Cessna (Aircraft) • Vick Chemical Company McQuay-Norris Manufacturing Company • New York State Electric & Gas Corporation



WINKLER INTER-PLANETARY TRANSMISSION
The only fully automatic stoker transmission—guaranteed for three years.

The fuel crisis has given to stoker-firing the job of keeping America in production! Coal has always been the low-cost, plentiful fuel. Now, with Winkler Stoker firing, it becomes an *automatic* fuel also.

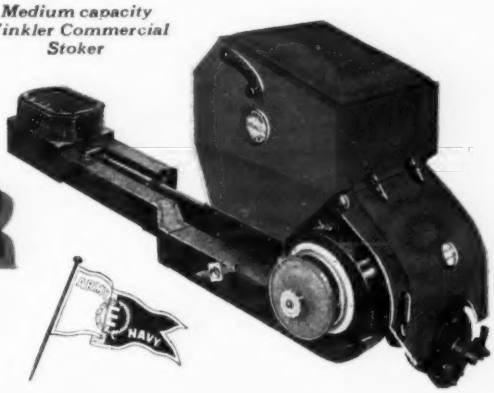
A Winkler Stoker gives you labor-saving heating . . . greater steam production . . . all for less money. The combination of cheaper stoker coal and Winkler Stoker efficiency literally *pays a profit* by substantially reducing operating expense.

Only the Winkler Stoker has the famous Inter-Planetary Transmission—a design which develops tremendous driving power. Foreign matter in the coal which ordinarily might mean a stalled stoker is *crushed* without interrupting service. It is the only *fully automatic stoker transmission*—with no shear pins to replace or switches to reset in case of an overload.

In every detail, the Winkler Stoker is a husky, rugged unit—built to last under the most adverse boiler-room conditions.

Complete engineering service—write to the factory for information

Medium capacity Winkler Commercial Stoker



WINKLER
fully automatic STOKERS
U. S. MACHINE CORPORATION • LEBANON, INDIANA

and for INSULATION ... *85% Magnesia*

EHRET'S 85% MAGNESIA and many other Ehret heat insulating materials are fully treated, both as to selection and application, in the 176-page Heat Insulation Handbook. It will be furnished, without obligation, to those interested in getting the most from their thermal insulations. Write today for your copy.

Be they the crude barrel-stave variety of the boy who makes his own, or the beautifully laminated products of the professional ski-maker, wood is the material of which skis are made. Time has shown that for lightness, strength, resilience, workability and other physical characteristics, wood is the *one* best material for the purpose.

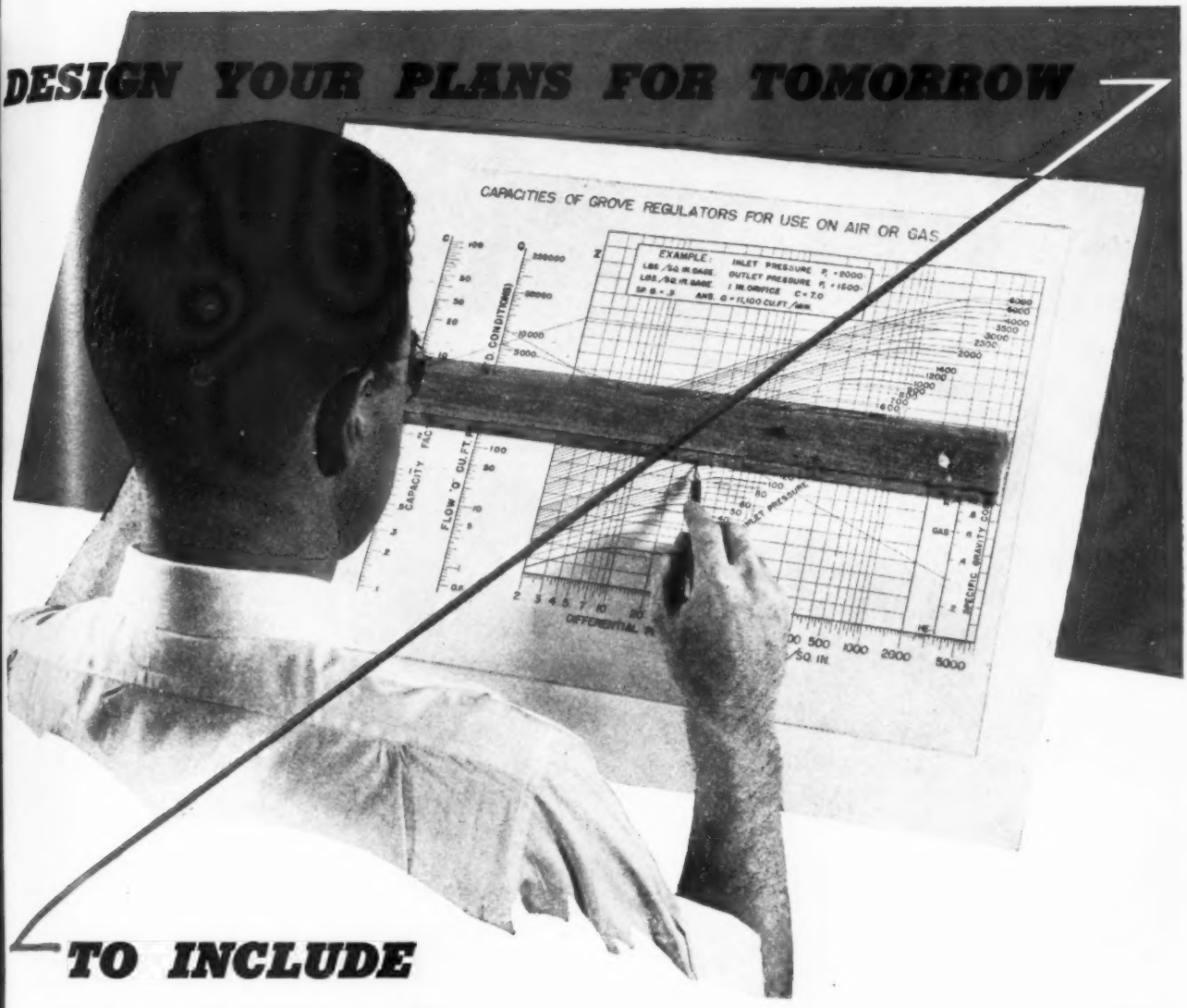
Likewise, in the field of pipe and boiler insulations, there is but *one* material that has been proved through more than half a century to be best suited for such services — namely, 85% Magnesia. Its time-defying high thermal efficiency and its ability to withstand the hazards of industrial use have made it the Standard Insulation.

It will pay you to continue to specify Ehret's 85% Magnesia.

EHRET MAGNESIA *Ehret* **MANUFACTURING CO.**
VALLEY FORGE, PENNA.

...THERE IS AN *EHRET* DISTRIBUTOR OR CONTRACTOR IN EVERY INDUSTRIAL AREA

DESIGN YOUR PLANS FOR TOMORROW



TO INCLUDE

GROVE *Pressure and Flow Controls*

Through the exigencies of war, today's new developments have already been thoroughly tested and proved for your use tomorrow. Veritable years of experience have been condensed into a concentrated period of a comparatively few months. As a result tremendous engineering advancements have been perfected by Grove in the pressure and flow control of air, gases and fluids. In consequence you will be better able to design new economies and greater efficiencies into your operations. Before drafting any plans, consult Grove Engineering concerning your specific needs or problems. Ask for full information on Grove Pressure and Flow Controls.

INVESTIGATE GROVE CONTROLS FOR GREATER ACCURACY IN HANDLING AIR, GASES & FLUIDS

- ★ *AIR, GAS & STEAM PRESSURE REDUCING VALVES*
- ★ *REMOTE CONTROL SHUT-OFF VALVES*
- ★ *AUTOMATIC REDUCING & STOP VALVES*
- ★ *FLEXIBLE TUBE TYPE VALVES*
- ★ *COMPLETE PRESSURE CONTROL SYSTEMS*

GROVE

GROVE SIMPLICITY ACCURACY SAFETY

Pressure and Flow Control
SYSTEMS & EQUIPMENT

GROVE REGULATOR COMPANY
1190 - 67TH STREET, OAKLAND (8), CALIFORNIA
BRANCH OFFICES: *5644 NAVIGATION BLVD., HOUSTON (11), TEXAS • 30 ROCKEFELLER PLAZA, NEW YORK CITY (20), N. Y.*

ABRUPT LOAD CHANGES FROM 10,000 TO 80,000 POUNDS STEAM

•

UNIFORM PRESSURE MAINTAINED

•

REPORT OVER 88% EFFICIENCY

DETROIT ROTOGRATE STOKER

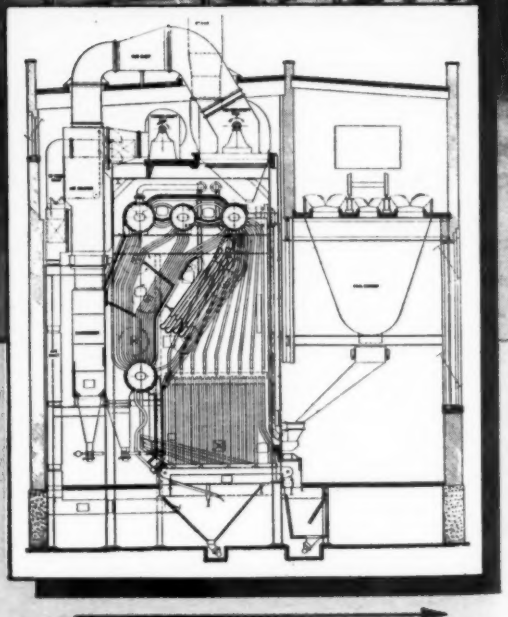
Detroit

Steam Generator and Detroit RotoGrate Stoker designed for:

75,000# hr. continuous capacity • 450# pressure • 500°F-present steam temperature • 750°F-future steam temperature • 250°F-air for combustion

Heating Surfaces:

Boiler—7050 sq.ft. • Water walls—262 sq.ft. (projected area) • Superheater—693 sq.ft. (present area), 1655 sq.ft. (future area) • Economizer—3696 sq.ft. • Air heater—6540 sq.ft.

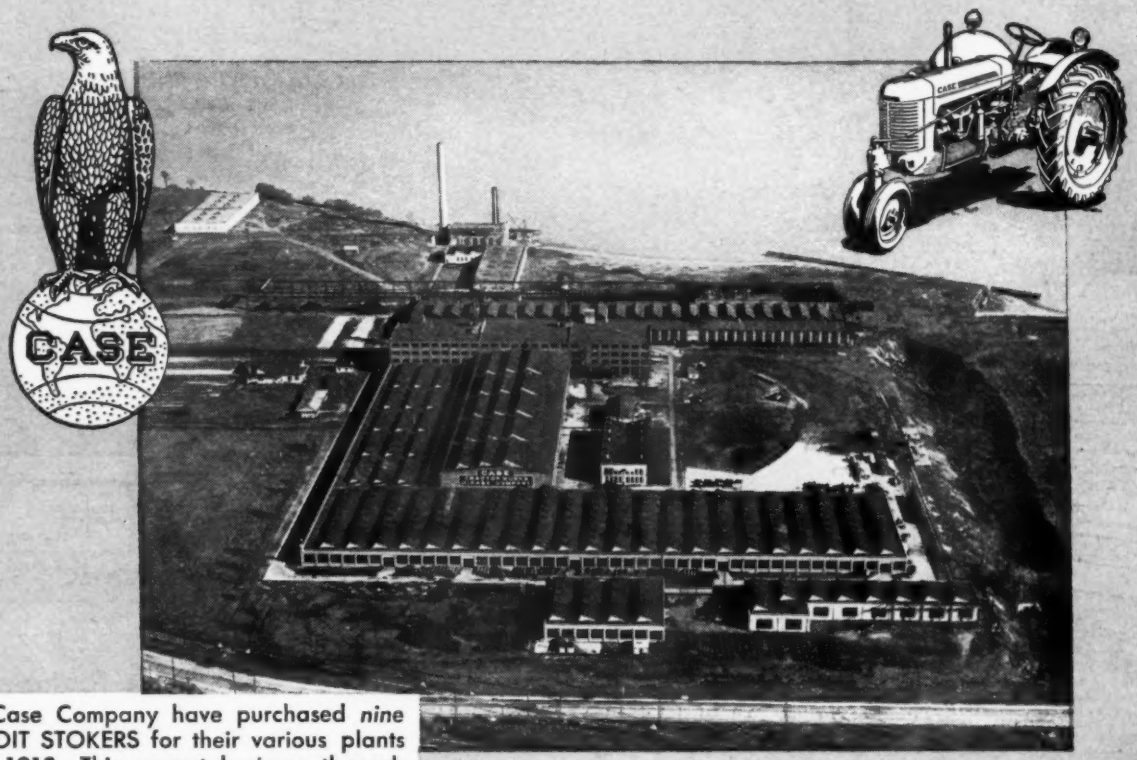


CONTINUOUS CLEANING GRATE MOVES FORWARD

RotoGrate Stoker

At J. I. Case Company

Tractor Works—Racine, Wisconsin



J. I. Case Company have purchased *nine* DETROIT STOKERS for their various plants since 1913. This repeat business through the years is significant.

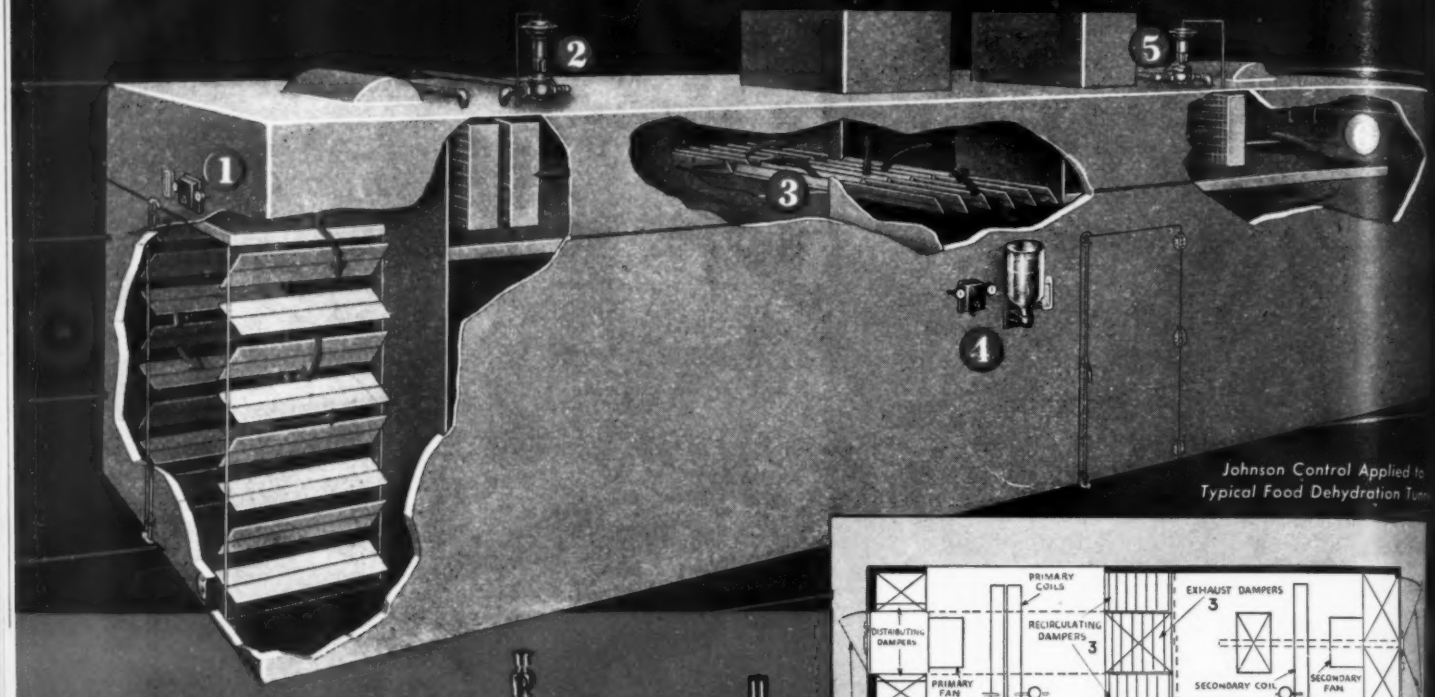
Investigate the recent development for greater Economy in the Production of steam. The RotoGrate combines all the advantages of *suspension burning* with a *forward moving grate.* Ashes are *continuously* discharged at the front of the boiler. No clinker troubles. Operation is smooth and uninterrupted and requires an extremely small amount of power.

Write now for Literature

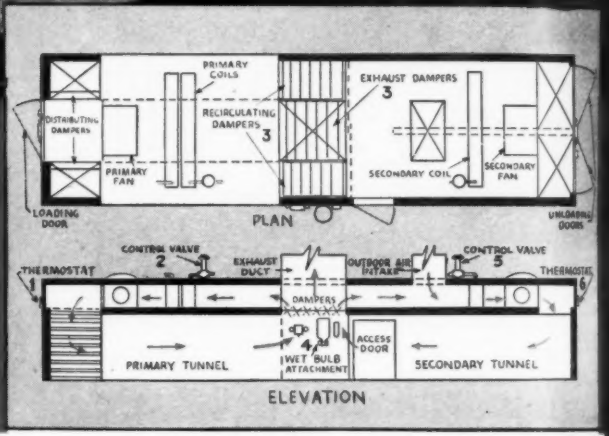
DETROIT STOKER COMPANY

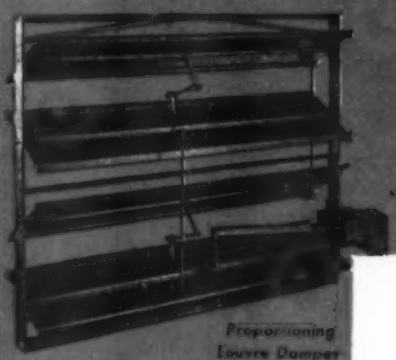
General Motors Building • Detroit 2, Michigan

Johnson Control for Dehydration Tunnels



Johnson Control Applied to Typical Food Dehydration Tunnel





Capillary Insertion Thermostat

Proportioning Louvre Damper

Streamline Diaphragm Steam Valve

Wet-Bulb Attachment for Thermostat

Exact Temperatures and Humidities Prevent Spoilage of War Foods During Processing

Johnson versatility was never better demonstrated than in the dehydration of foods. Here again, Johnson Wet-Bulb and Dry-Bulb Controls maintain the optimum air conditions for the proper processing of foods, so necessary to the successful prosecution of the war.

In the above view, Johnson Insertion Thermostat No. 1 controls Diaphragm Steam Valve No. 2 to maintain the desired dry-bulb temperature in the primary tunnel.

Proper humidities are maintained by positioning the Return Air and Exhaust Dampers No. 3, as required, through piston-type damper motors, operated by Johnson Wet-Bulb Controller No. 4.

Final dry-bulb temperatures, as required by Government standards, are maintained in the secondary tunnel through the control of normally closed Diaphragm Valve No. 5, operated by Johnson Dry-Bulb Controller No. 6.

* *Johnson Controllers are used, too, for the control of other food processing accessory equipment such as caustic peelers, etc.*

THE PROPER ATMOSPHERE

JOHNSON *Automatic Temperature and Air Conditioning Control*

JOHNSON SERVICE COMPANY, MILWAUKEE 2, WIS. · DIRECT BRANCHES IN ALL PRINCIPAL CITIES

BUY MORE WAR BONDS

"SAWING WOOD AND SAYING NOTHING". . . . *an old American saying*

~~Sawing Wood~~ Sawing Steel

Billet saw preparing material for steam drop hammers at Vogt plant.

and keeping WAR PRODUCTION MOVING FASTER FOR VICTORY

We're attending strictly to business here at Vogt's and quickening the tempo of War Production without fuss or feathers. Vogt Products for Power Plants, Chemical Plants, Oil Refineries, Ship Yards, Powder Plants, Synthetic Rubber Plants, etc., are being delivered in ever increasing volume to meet the requirements of the War Program FOR VICTORY!

Vogt

PRODUCTS HAVE GONE TO WAR

★ DROP FORGED STEEL VALVES FITTINGS AND FLANGES

★ OIL REFINERY AND CHEMICAL PLANT EQUIPMENT

★ WATER TUBE BOILERS

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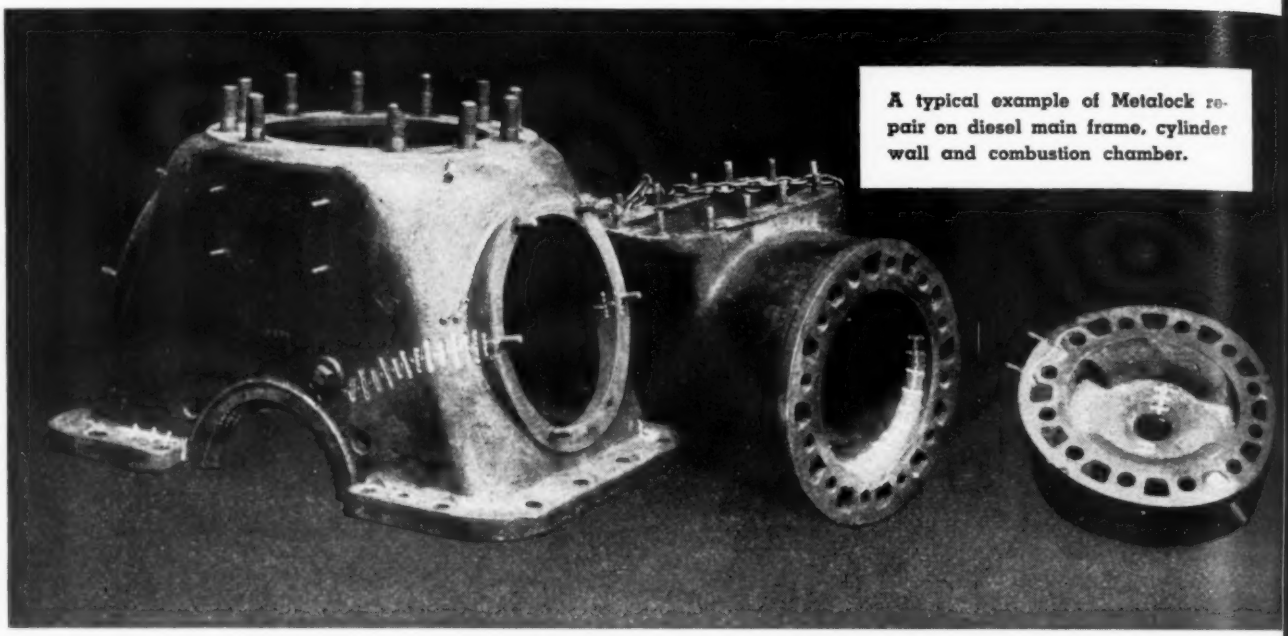
★ HEAT EXCHANGERS

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.
Branch Offices: NEW YORK PHILADELPHIA CLEVELAND CHICAGO DALLAS

BUY WAR BONDS AND GET IN THE SCRAP

LET METALOCK PERMANENTLY REPAIR YOUR
DAMAGED CASTINGS
(CRACKED OR BROKEN)



A typical example of Metalock repair on diesel main frame, cylinder wall and combustion chamber.

PROVED NEW COLD PROCESS SAVES COSTLY DELAYS OR COMPLETE SHUTDOWNS—AVOIDS NEED FOR NEW EQUIPMENT

METALOCK & MASTERLOCK ARE USED TO REPAIR:

All castings of steam, gas, gasoline, electrical, and diesel equipment; heavy frames including those of punch presses & power hammers; crankshafts, shafting; flywheels; pumps of all pressures; sectional boilers; laundry equipment; steel members; defective sections removed. Special attention to wrecks.

Metalock cold process for quick, money-saving repair of damaged castings has proved successful on all pressures and temperatures up to color point. Practically all repairs permanent —many guaranteed for life of casting whether iron, steel, brass or aluminum. Metalock *uses no heat*—renews strength with safety factor, stops leaks, redistributes stresses, eliminates stress points. Successful repairs made for Standard Oil, Eastman Kodak, Du Pont, Hartford Steam Boiler & Inspection Company, General Motors and hundreds of others. Send in letterhead today for descriptive Metalock booklet. (See below.)

METALOCK and MASTERLOCK
Metalock Casting Repair Service
P. O. Box 314, Columbus, Ohio

Metalock is a specialized service requiring considerable training and experience. We sell service. All repairs are fully guaranteed. Save your castings by sending them with Priority for repairing to:

Main Office
Columbus, Ohio
451 E. Town St.
Tel. ADams 4727
L. B. Scott, Patentee and Mgr.
Shop & Training Center
302 North Ludlow St.,
Columbus, Ohio

Salem, Illinois
Box 240
Shop at Spencer Harris Mach. & Tool Co.
(V. A. Reese)

Marcus Hook, Pa.
26 East 10th St.
(J. H. White)

Western Office
Berkeley, California
2961 Ashby Ave.
(A. J. Nicholson, Mgr.)

Tulsa, Okla.
Box 1291
(C. W. Browning)

Ashland, Ohio
241 West Main St.
(W. E. King)

Oklahoma City, Okla.
Box 4546 — Capitol Hill Station
(The Eureka Tool Company)

Shreveport, La.
Box 888
(J. B. Gilbert)

Crowley, Louisiana
Box 134
(F. C. Williams)

Wichita Falls, Texas
Box 2450
(M. J. Bills)

Dallas, Texas
4240 Fair St.
(R. L. Williams)

Gladewater, Texas
Box 466
Shop at Spencer Harris Mach. & Tool Co.
(C. O. Spencer & Son)

San Rafael, Calif.
1522 Fourth St.
(North Bay Electric Works, Inc.)

San Antonio, Texas
1923 Fredericksburg Rd.
(Joe P. Brown)

Taylor, Texas
(Taylor Iron & Machine Company)

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451 North Alameda St.
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210 North American St.
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Klamath Falls, Oregon
734 South 6th St.
(J. W. Kerns Company)

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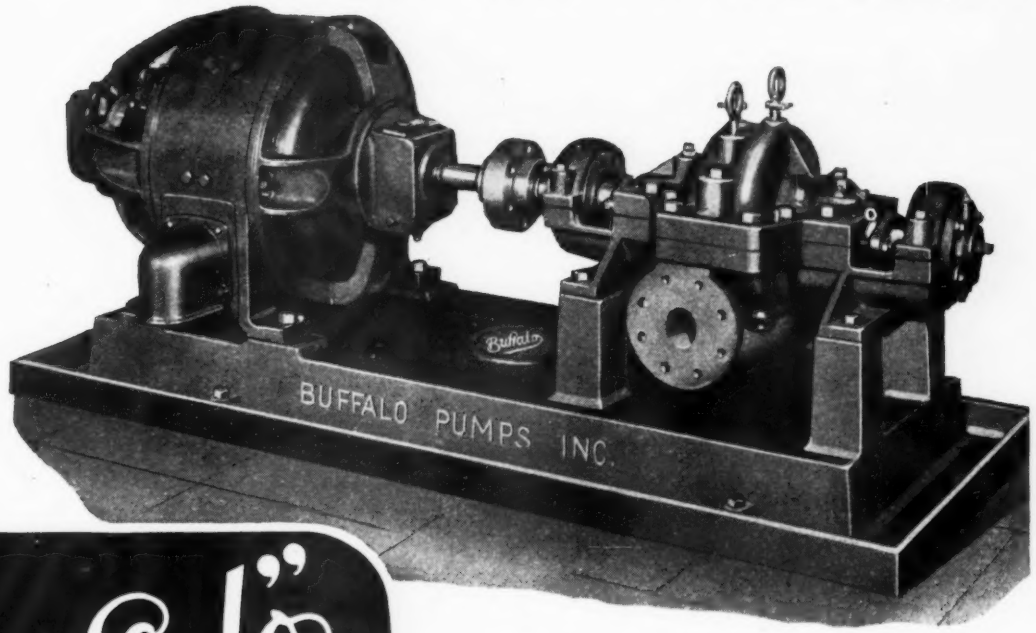
BACKING UP THE BOILERS

to help deliver ENOUGH *power* AND ON TIME!



"Buffalo" PUMPS

★ Buffalo Boiler Feed Pumps are sure on the warpath these days—supplying boilers hard-pressed by industry's command for more and more power—peak power loads for sustained periods.

Operating smoothly, quietly and with practically no attention, Buffalo Pumps are living up to their 60-year reputation for dependability under severe service demands . . .

. . . yes, and when power is reconverted to peace production, Buffalo Pumps will still be on the job, helping build the things of tomorrow.

BUFFALO PUMPS, INC.

488 Broadway — Canada Pumps, Ltd., Kitchener, Ont. — Buffalo, N. Y.

You Don't Remove a DARLING VALVE from the Line..

LUCKY BREAK, wasn't it, the day you installed those Darling Double Disc Gate Valves. It means that you don't have to worry about slowing down production to remove worn, leaky, faulty valves from the line. Longer life, tighter seating, better service *are designed into* Darling Valves, with 4 simple parts that have stood up under industry's toughest jobs for years.

When, after long and severe service, the parts should become worn, you don't remove the valve from the line. You simply replace two discs and two wedges—4 inexpensive parts—the entire working assembly of a Darling Double Disc Gate Valve.

It may be diffcult to get Darling Gate Valves today. Most of Darling's output has been enlisted to help float Uncle Sam's ships to victory. Replacement parts are available. New valves will also be available for shipment immediately following government release from present commitments, on or before the time the war is over.

Only 4 PARTS

Two discs and two wedges—the entire working part assembly of a Darling Double Disc Gate Valve. There is no other valve with this design. The seats are parallel. The discs are *fully revolving*, seating in a different position each time the valve is operated. This means tighter seating, less wear, longer operation and lower maintenance costs with Darling Gate Valves.

You don't have to take a Darling Double Disc Gate Valve out of the line to replace the parts. Simply insert new and inexpensive assembly parts and replace Stem and Bonnet. Valve is again ready for long, hard service.

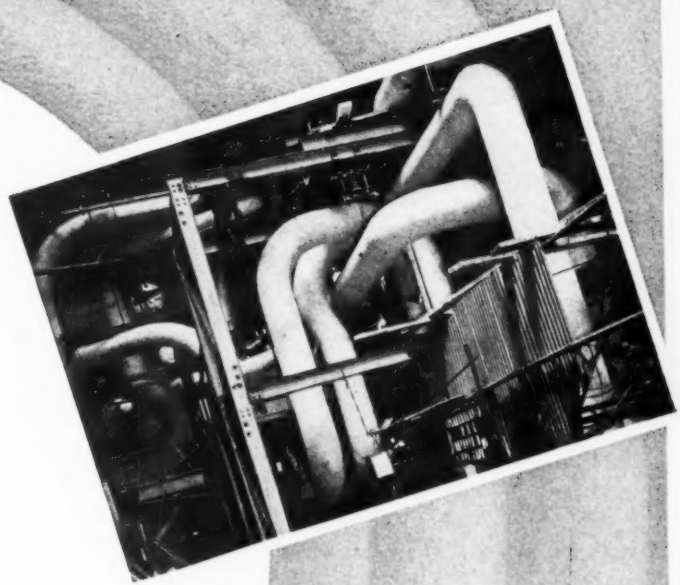
TRADE DARLING MARK

VALVE & MANUFACTURING CO.

WILLIAMSPORT, PA.

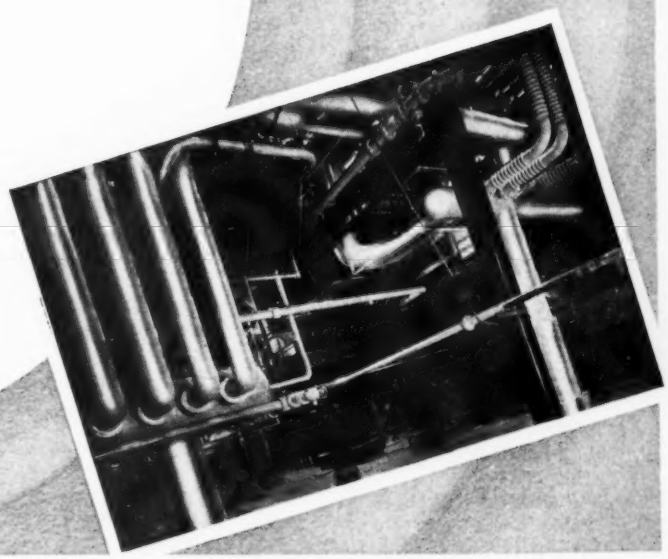
KELLOGG *Prefabricated* PIPING...

...Saves Time...Overcomes many complicated piping problems



Prefabricated assemblies for complicated piping systems designed with the aid of the KELLOGG Scientific Method of Determining Moments and Forces Electrically solve the most complex and highly specialized temperature and pressure requirements of public utility, process and marine power plants.

Consulting engineers and operators of central stations, industrial and marine power plants find that placing the entire responsibility of difficult piping installations with The M. W. Kellogg Company offers a satisfactory solution to their problems.



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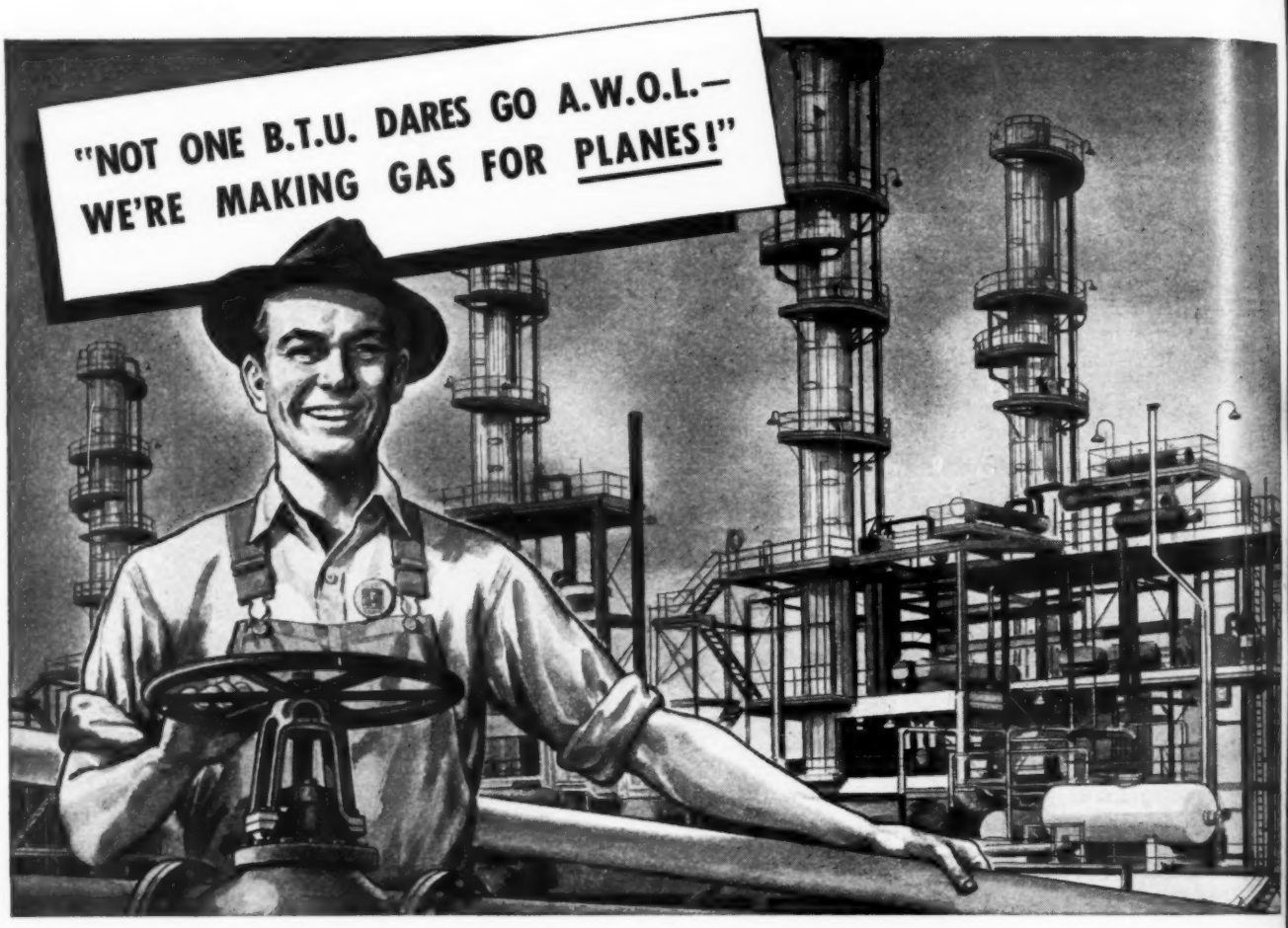
"Masterflex" Prefabricated Piping Systems • **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, NEW YORK 7, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND — TULSA: PHILTOWER BLDG.

Looking ahead with Asbestos



"We're seeing that every heat unit stays right on its wartime job in *this* refinery! 100 octane aviation gasoline is precious these days. That's why you find K&M Insulation our standard safeguard against heat loss."

Many an aviation gasoline refining plant is following that sound and effective practice. K&M 85% Magnesia Insulation is in service on hot process lines, steam lines, bubble towers, heat exchangers and reboilers, pre-heated air ducts and other vital places.

The remarkable efficiency of K&M 85% Magnesia in preventing heat loss—and so conserving power and saving fuel—has won it a high place in the opinion of engineers everywhere, throughout wartime industry.

In fact, K&M output of heat insulation has increased to a new all-time high. And the research that goes hand-in-hand with our production will make it possible for K&M to put this war-born capacity to the best of use in the "V" years to come.

* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer, has made it serve mankind . . . since 1873

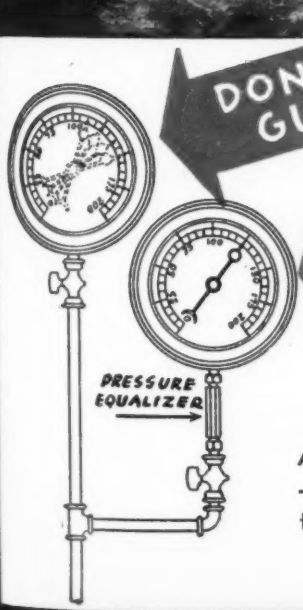
KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

ARMY E NAVY
K&M best in asbestos

★ Our Ambler plants proudly fly the Army-Navy "E" flag — an honor awarded K&M employees "for outstanding production of war materials."

NATIONAL GAUGE PRESSURE EQUALIZER

***Used by the* UNITED STATES NAVY**
Merchant Marine, Leading Railroads and Industrials



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Act as Pulsation Dampeners —Your instruments tell the truth.

PROTECTS YOUR GAUGES AND RECORDING INSTRUMENTS FROM HAMMER AND DAMAGE CAUSED BY SURGING, PULSATING PRESSURES

CHARACTERISTICS AND ADVANTAGES

1. Increases life of instrument.
2. Two parts its entire construction.
3. Same Equalizer used on 5 lbs. or on 50,000 lbs. pressures.
4. Can be transferred to any service without adjustment.
5. NO VALVE STEMS TO BEND.
6. NO DIAPHRAGMS TO REPLACE.
7. NO WORN OUT RUBBER SACS.
8. WILL NOT CLOG. LAST INDEFINITELY.
9. Its merit recognized by leading instrument and gauge. manufacturers.
10. MADE FOR ALL CONDITIONS AND PRESSURES.

NATIONAL ENGINEERING PRODUCTS, INC.

COMMERCE & SAVINGS BUILDING · WASHINGTON, D. C.

Representatives in Principal Cities of United States

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THOROUGH CLEANING

...another advantage of

MIDWEST

PRE-FABRICATED PIPING

Piping subassemblies that are pre-fabricated by Midwest are thoroughly cleaned before leaving our various plants. All scale, dirt and other accumulated impurities that otherwise would cause serious damage to valves, turbine blading, etc. are removed.

You do not have to waste time in cleaning Midwest Pre-Fabricated Piping . . . it is delivered ready to erect. The careful checking in our shops to make sure dimensions and alignment are correct . . . the searching inspection and shop testing . . . are other important time-saving advantages of Piping by Midwest.

• • •

Midwest Piping Service can be used to advantage whenever you need piping . . . whether a simple pipe bend or a complex high pressure piping job. Three modern fabricating plants are strategically located to serve you . . . and an experienced Erecting Division will take full responsibility for a complete piping installation.

MIDWEST

PIPING & SUPPLY COMPANY, INC.

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Plants: St. Louis, Passaic (N. J.) and Los Angeles

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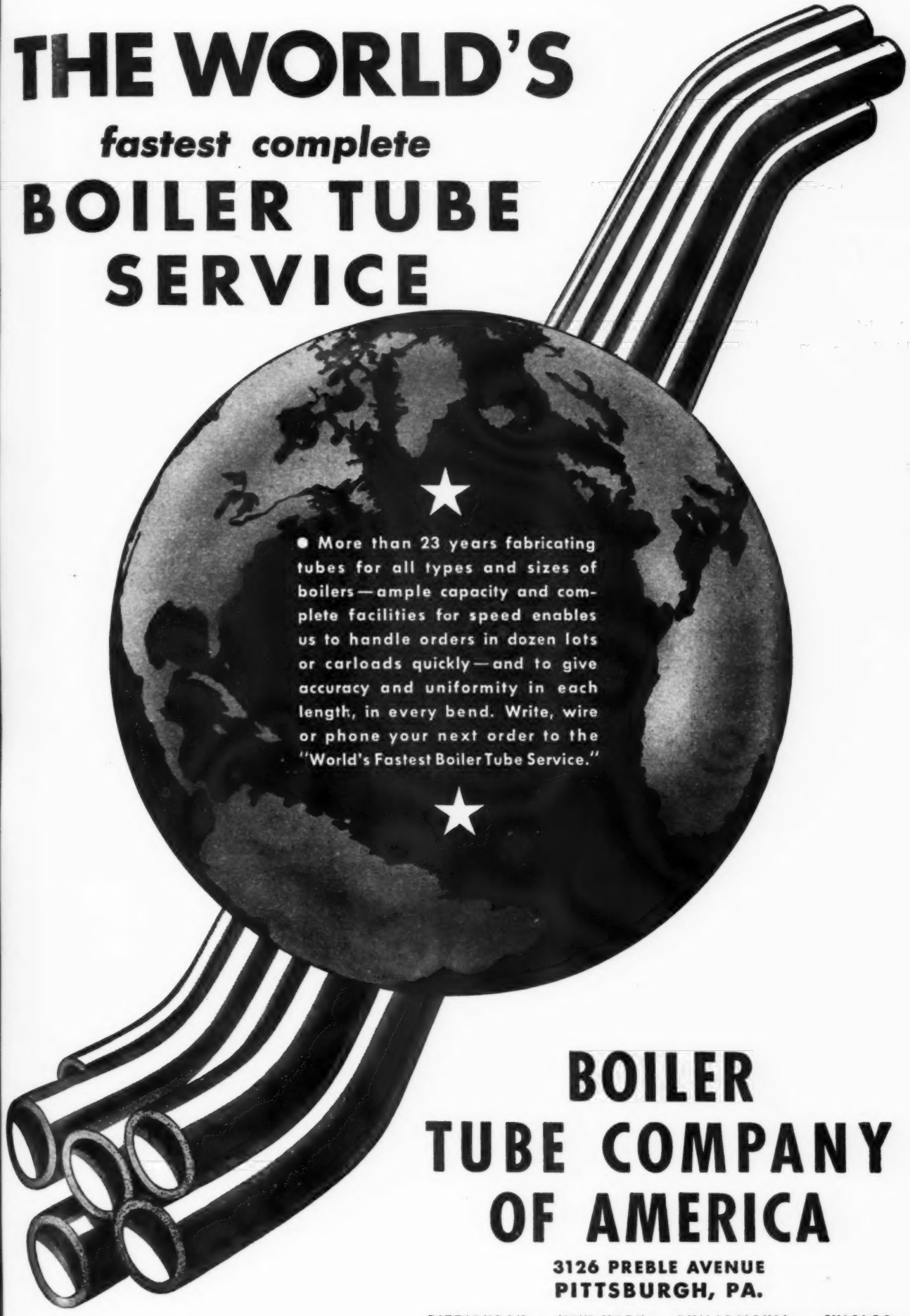
THE WORLD'S *fastest complete* BOILER TUBE SERVICE



● More than 23 years fabricating tubes for all types and sizes of boilers—ample capacity and complete facilities for speed enables us to handle orders in dozen lots or carloads quickly—and to give accuracy and uniformity in each length, in every bend. Write, wire or phone your next order to the "World's Fastest Boiler Tube Service."

BOILER TUBE COMPANY OF AMERICA

3126 PREBLE AVENUE
PITTSBURGH, PA.

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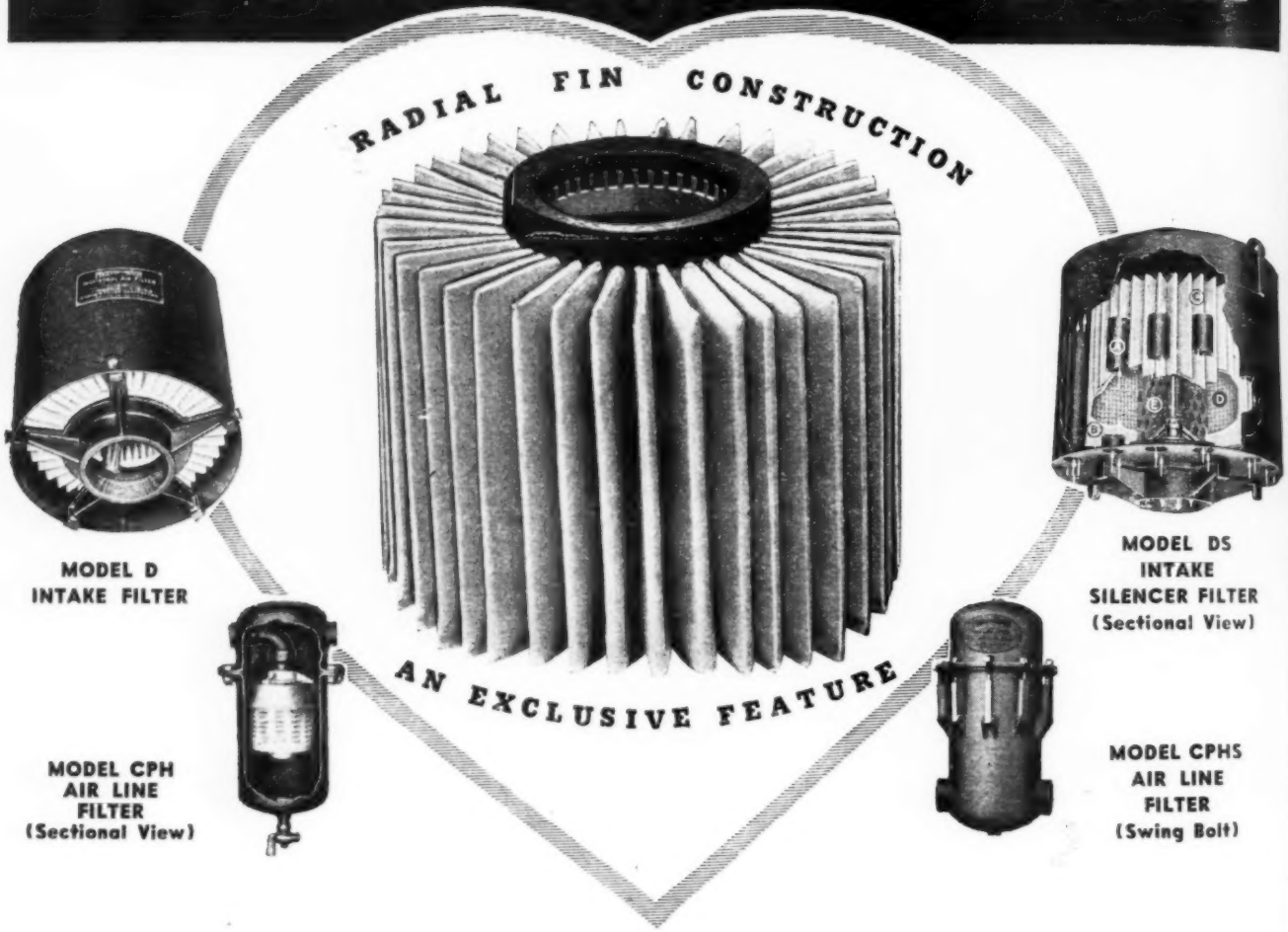
THE HEART OF EVERY PROTECTOMOTOR


RADIAL FIN CONSTRUCTION
AN EXCLUSIVE FEATURE
MODEL D INTAKE FILTER
MODEL DS INTAKE SILENCER FILTER (Sectional View)
MODEL CPH AIR LINE FILTER (Sectional View)
MODEL CPHS AIR LINE FILTER (Swing Bolt)

I. Provides DRY TYPE filtration.

(a) Positive—dry filter medium does not require periodic addition of any viscous coating or other filter aid.

(b) Can be selected oversize for severe conditions—does not depend on closely held air velocities for its ability to function.

(c) Essential for air intake of non-lubricated compressors.

(d) Performance unaffected by temperature changes.

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II. Provides largest possible active filtering area in relation to space occupied (low resistance to air flow).

III. Provides rigid construction—(Radial Fin design eliminates presenting of broad flat surfaces to compressor and engine intake pulsations).

Representatives in Principal Cities

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PEDRICK PRECISION assures air pressures

WHERE TWO-PLUS-TWO MAKES ONE THAT CAN FIGHT...

● In mechanized warfare, salvage of damaged equipment is second only to salvage of human lives. Behind the lines on every front, mobile repair-shops handle parts, pieces, and patches . . . fix tanks, planes, trucks, and guns so they will be fit to fight again.

Pedrick *precisioneered* piston rings are in the air compressors that are part of these amazing machine-shops-on-wheels. Pedrick rings have long been original equipment in the country's leading air compressors, delivering maximum cubic feet of air per minute through years of uninterrupted service.

Correct and lasting tension, precise dimensions, absolute flatness, distinguished metallurgy . . . these are among the characteristics which make Pedrick piston rings *precisioneered,* make them stand-outs in performance and long life, whether in the fighting, transporting, or maintenance equipment of our armed forces, or in the many kinds of power units which keep our essential domestic economy running.

Through these war years, Pedrick's great store of know-how in piston ring design and manufacture is contributing notably to the nation's war effort . . . will contribute just as notably to the vast power needs of a nation and a world at peace.

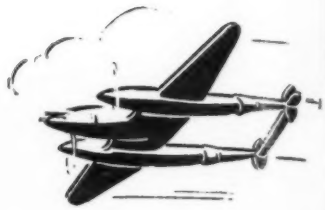
WILKENING MANUFACTURING CO., Philadelphia and Scranton, Pa. *In Canada:* Wilkening Manufacturing Co. (Canada) Ltd., Toronto.

A MESSAGE TO POWER ENGINEERS

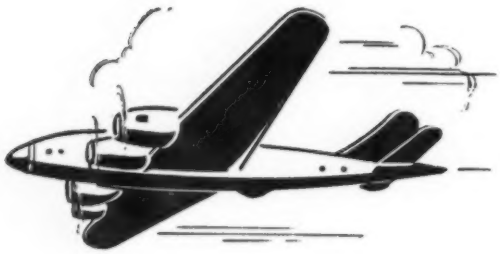
The job Pedrick *precisioneered* piston rings are doing on the war front is the best promise we know for the power, performance, and life they can give to the engines on the home front. Write for a copy of our latest catalog, which describes exclusive features of Pedrick production, illustrates individual ring designs and how they are combined for best results on different pistons.—

IT ISN'T OVER, OVER THERE . . . SO KEEP ON BUYING WAR BONDS HERE

Pedrick *precisioneered* PISTON RINGS



Tens of Thousands of feet altitude and still on the ground!



Supercharged engines are playing a tremendous part in our high-altitude fighting and bombing. The superchargers must be absolutely right for the job—which means careful testing.

A leading manufacturer was faced with the problem of duplicating altitude conditions at the exhaust of the gas turbines used for driving their superchargers. Specifically, the problem involved the use of vacuum apparatus to handle large volumes of hot exhaust gases at suction pressures corresponding to tens of thousands of feet in the air.

After studying all phases of the problem with Ingersoll-Rand, the manufacturer installed several large steam jet ejectors—largely because of the reliability, simplicity, compactness, and ease of operation secured with such apparatus.

Repeat orders indicate the success of this solution of an important war production problem.

May we cooperate with you in the application of vacuum apparatus?

Ingersoll-Rand
11 BROADWAY, NEW YORK, N. Y.

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CENTRIFUGAL PUMPS • CONDENSERS • COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES

A COMPLETE LINE OF SPECIAL VALVES
FOR SPECIAL SERVICES . . .

GOLDEN-ANDERSON *Specialty Valves*

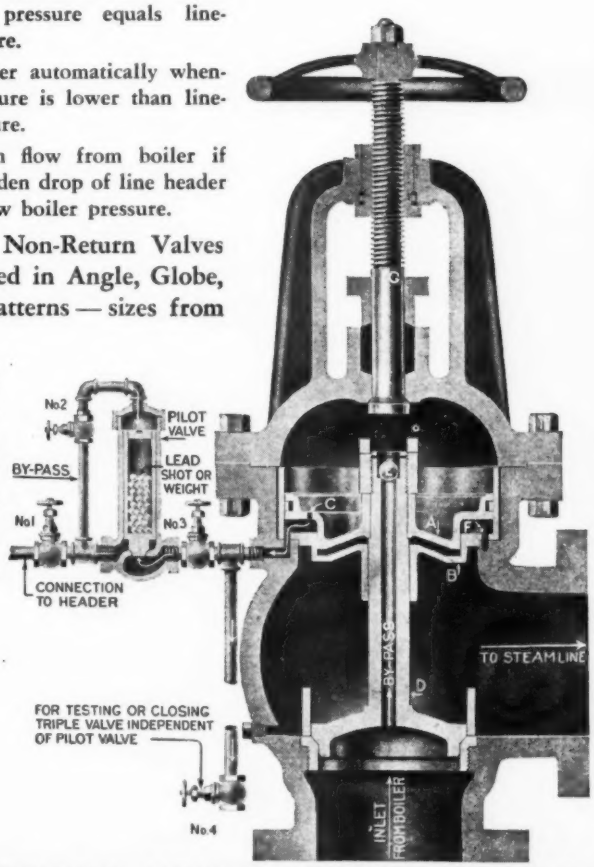
To insure that the valves you buy fit the service for which they are selected—specify GOLDEN-ANDERSON.

FOR EXAMPLE—here is the G-A Triple-Acting Non-Return Valve, capable of meeting any emergency caused by blown tubes or ruptured high pressure lines. This valve will—

- —automatically cut in a boiler whenever boiler pressure equals line-header pressure.
- —isolate a boiler automatically whenever its pressure is lower than line-header pressure.
- —prevent steam flow from boiler if there is a sudden drop of line header pressure below boiler pressure.

G-A Triple-Acting Non-Return Valves are regularly supplied in Angle, Globe, Cross and Elbow patterns — sizes from 2½″ to 12″.

Information on GOLDEN-ANDERSON'S *complete* line of Special Valves for Special Services is readily available . . . write today.



GOLDEN-ANDERSON VALVE SPECIALTY CO.

1300 FULTON BLDG. PITTSBURGH, PENNA.

for THIS battle, G.H.Q. is at YOUR own desk!

★ Here's how you—yes, YOU—can carry out a smashing "pincer movement" against the Axis. Swing in on one flank with increased production of war goods! Drive in on the other with redoubled purchases of War Bonds through your Pay-Roll Savings Plan!

You're an officer in both of these drives. Your personal leadership is equally vital to both. But have you followed the progress of your Pay-Roll Savings Plan as closely as you have your production?

Do you know about the new Treasury Department quotas for the current Pay-Roll Allotment Drive? *Quotas running about 50% above the former figures?* You see, these new quotas are based on the fact that the armed forces need more money than ever to win the war, while the average worker has more money than ever before to spend. Particularly so, on a *family income* basis—since in so many families several members are working, now.

Remember, the bond charts of today are the sales curves of tomorrow! Not only will these War Bonds implement our victory—they'll guard against inflation, and they'll furnish billions of dollars of purchasing power to help American business re-establish itself in the markets of peace.

So get this new family income plan working at once. Your local War Finance Committee will give you all the details of the new plan. Act today!

This advertisement prepared under the auspices of the War Advertising Council and the U. S. Treasury Department.

LET'S KEEP ON Backing the Attack!

This Space is a Contribution to America's All-Out War Effort by

POWER

New ELECTRONIC POTENTIOMETER

Eliminates Manual Balancing

NO longer is it necessary to manually balance an Indicating Potentiometer to obtain temperature readings.

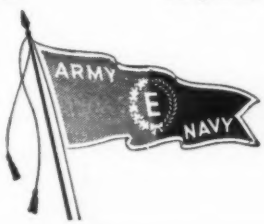
The new Brown Electronic "Self-balancing" Precision Indicator reads the correct temperature instantly when the operator throws the proper key switch.

This new instrument utilizes the standard "Continuous Balance" electronic principle incorporated in the well-known Brown Circular Chart Air-O-Line Potentiometer Controller. It uses no conventional galvanometer and is not affected by vibration.

Precision readings are made possible by the use of a rotating scale, over 28″ in length, graduated to permit readings to within one part in 2400. This scale is power driven and can travel through full range in less than 10 seconds. There is no waiting for a galvanometer to balance — the instrument balances quickly without cycling.

The Brown Precision Indicator can be used with any number of separately mounted key switches, in exactly the same manner now employed in manually balanced instruments. Integrally mounted push button switches will also be available in limited quantities.

WRITE THE BROWN INSTRUMENT COMPANY, 4490 Wayne Avenue, Philadelphia, Pennsylvania, a division of Minneapolis - Honeywell Regulator Company, Minneapolis, Minnesota. Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden



Instruments by **BROWN** *and Controls by*

MINNEAPOLIS-HONEYWELL

PIPE FITTING TOOLS

"TOLEDO" offers sturdy open-side pipe vises in three models No. 00 capacity ⅛ to 1½ inch pipe. No. 0 capacity ⅛ to 2½ inch pipe. No. 3 capacity ⅛ to 4½ inch pipe. Excellent for fitting make-up work.

Ratchet pipe reamers that quickly remove burrs from pipe ends. Junior Ratchet capacity ⅛ to 2 inch pipe. Ratchet Reamer capacity ⅜ to 3 inch pipe. Natural hand grip assures easy operation.

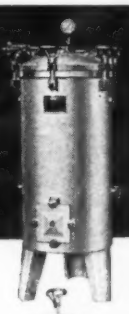
Sold by leading suppliers everywhere.

THE TOLEDO PIPE THREADING MACHINE CO.
TOLEDO, OHIO — NEW YORK OFFICE, No. 2 RECTOR ST.

"TOLEDO"
TRADE-MARK REGISTERED U.S. PAT. OFFICE

BUY WAR BONDS AND WAR STAMPS

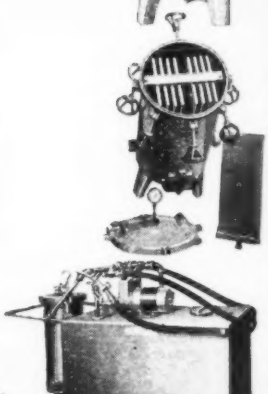
MATERIALS MEN MACHINES } Are Hard to Get



SAVE THEM BY REDUCING SCRAP!

LET BOWSER TELL YOU
HOW WAR PLANTS ARE REDUCING SCRAP WITH MODERN FILTRATION SYSTEMS FOR CUTTING OILS COOLANTS HYDRAULIC OILS AND OTHERS
BOWSER

Scrap reduced 42% . . . production upped 27%, two men released from one operation, wheel dressing cut 80%, two expensive machines released for other work . . . these are a few of many actual experiences of plants who have installed Bowser Filtration systems for cutting oils and coolants. To help you do better work . . . and more of it, call in Bowser. A wide range of continuous, batch, self-cleaning or sterilizing filters . . . wheel tanks, lubricating systems and devices are at your service. Write for further details.



ARMY NAVY Buy WAR BONDS and STAMPS

S. F. BOWSER & CO., INC.
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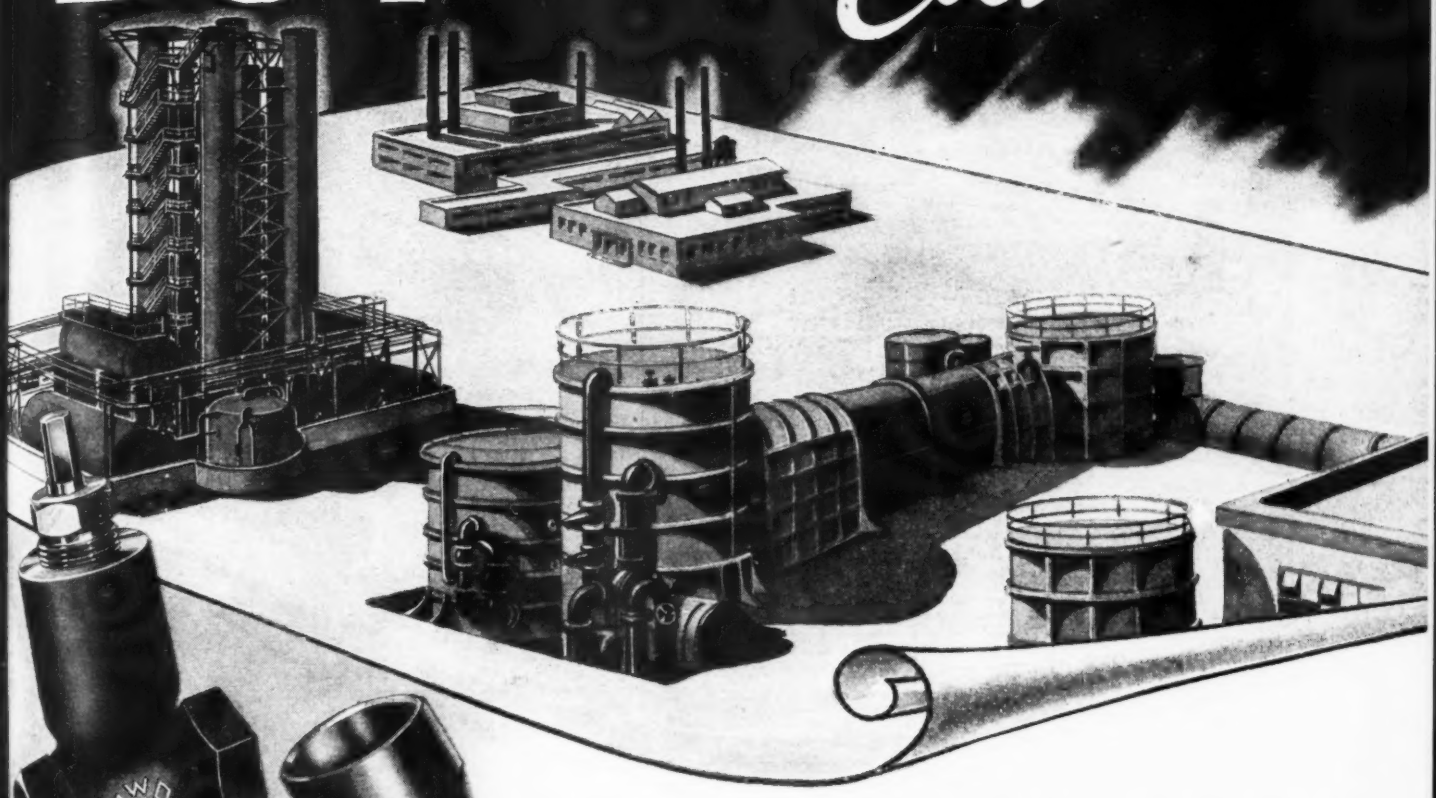
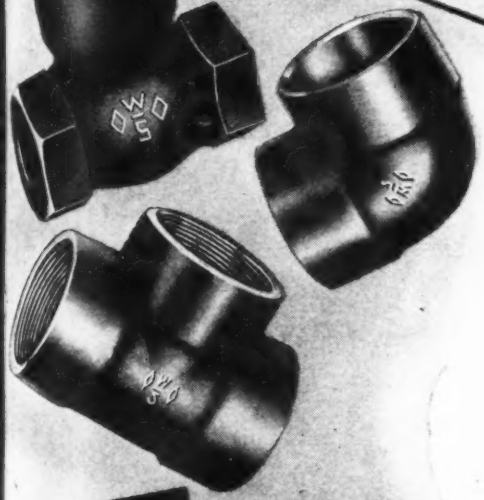
LIQUID CONTROL SPECIALISTS SINCE 1885
METERING • DISPENSING • STORING • LUBRICATING • FILTERING • DISTILLING

BUY *Low Maintenance Cost*





In buying valves and forged steel fittings, first cost is *less* important than final cost. Watson-Stillman valves and fittings are recognized by engineers because of their High Quality and Dependability. Inferior valves and fittings are likely to cause interruptions in service, which are costly in loss of time and production creating a *high* maintenance cost.

The materials that go into W-S fittings and valves conform to specified chemical and physical properties, to insure perfection of metal structure. Machining is done on special automatic machines, guaranteeing accuracy and uniformity and eliminating the possibility of failure in the field.

When you are BUYING fittings and valves specify Watson-Stillman, with the Double-Diamond Emblem of Quality. The Watson-Stillman Company, Roselle, N. J.

These Booklets contain authoritative, factual information on Watson-Stillman forged steel fittings, valves, wire rope shears, hydraulic jacks and pumps. Send for the copy you need.

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Engineers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Pumps, Jacks, Hydraulic Machinery and Equipment.

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INVEST IN THE INVASION ★ THIRD VICTORY LOAN ★ BUY BONDS

"OUR CANTON STOKERS DID NOT FAIL US WHEN THE CHIPS WERE DOWN" SAYS COPPERWELD STEEL COMPANY

A TYPICAL EXAMPLE OF CANTON'S EFFICIENCY AND DEPENDABILITY

▶A 450 H. P. heating load, a 1,000 ton press, and 17 pickling tanks create a heavy demand for steam at Copperweld Steel Company. And while awaiting delivery of additional boilers during the winter of 1942-43 no "let down" was possible—two of the four CANTONS purchased were on the line CONTINUOUSLY.

401,500 LBS. OF STEAM IN 23 HOURS

While maintaining this heavy demand with wide fluctuations, they report steam pressures always held constant. It's the usual story with CANTONS—hundreds of well-known plants report top efficiency, fuel savings, and low maintenance costs even under peak load operations.

THE LOGICAL ANSWER TO YOUR PERMANENT FUEL BURNING NEEDS

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▶Save 20% to 50% in fuel costs with Canton Stokers. Immediate deliveries from stock for jobs up to 800 H. P. The ONLY Stoker GUARANTEED Five Years. Write or wire for cost saving facts now.

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.....Send complete facts about CANTON Stokers at once.

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Company.....

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City.....*State*.....

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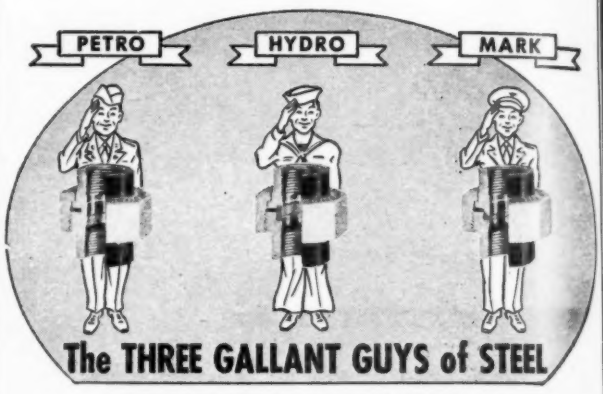

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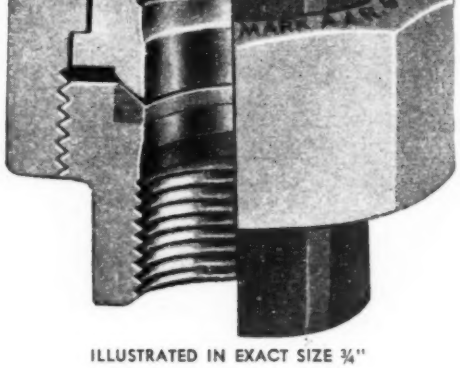
1. EXCESS STRENGTH.
2. PERMANENTLY LUBRICATED NUT THREADS.
3. BRONZE SEAT BRAZED TO THE STEEL, THEN MACHINED AND COLD ROLLED.

"MARK A.A.R."



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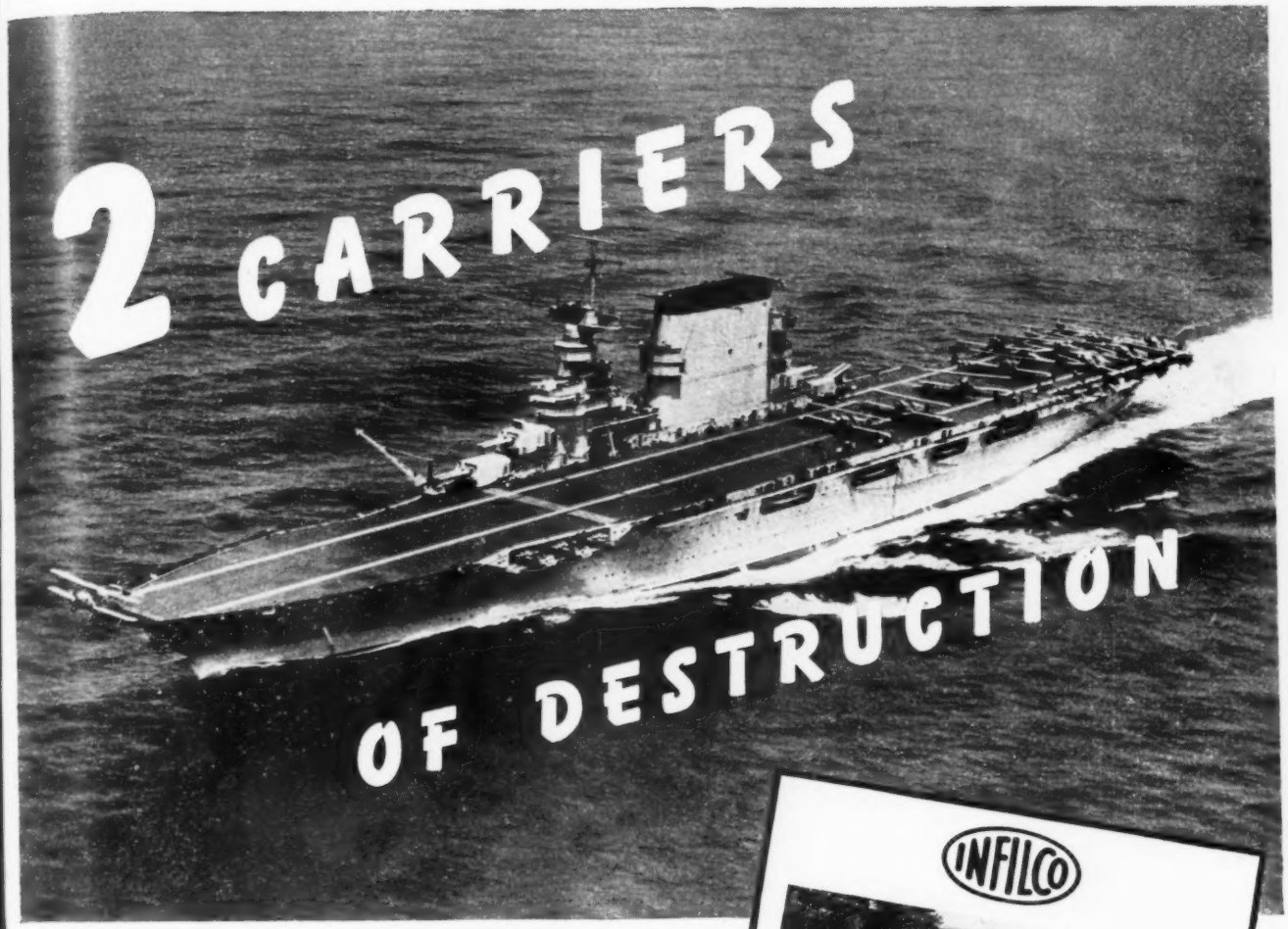
Clayton **MARK** *& Company*

PIONEERS OF STEEL UNIONS SINCE 1912

Evanston **Illinois**



Spectacular and instantaneous destruction results from the explosion of a Navy Bomber's torpedoes.

Destruction that is silent . . . perhaps slow . . . but nevertheless sure . . . can be carried by water into vital spots of your power plant.

Water . . . unless conditioned against scale, corrosion, embrittlement, oil, etc. . . . can destroy power plant equipment, efficient operation and fuel as effectively as a bursting torpedo.

Power plants, vital to the War Effort, are offered the protection of Infilco equipment for boiler and evaporator feedwater treatment, condensate oil removal, steam purification, cooling water conditioning, etc. The engineering staff and manufacturing facilities of this 48-year old organization are at your service.

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HOW does the Accelator process accomplish such remarkable results in such small space?

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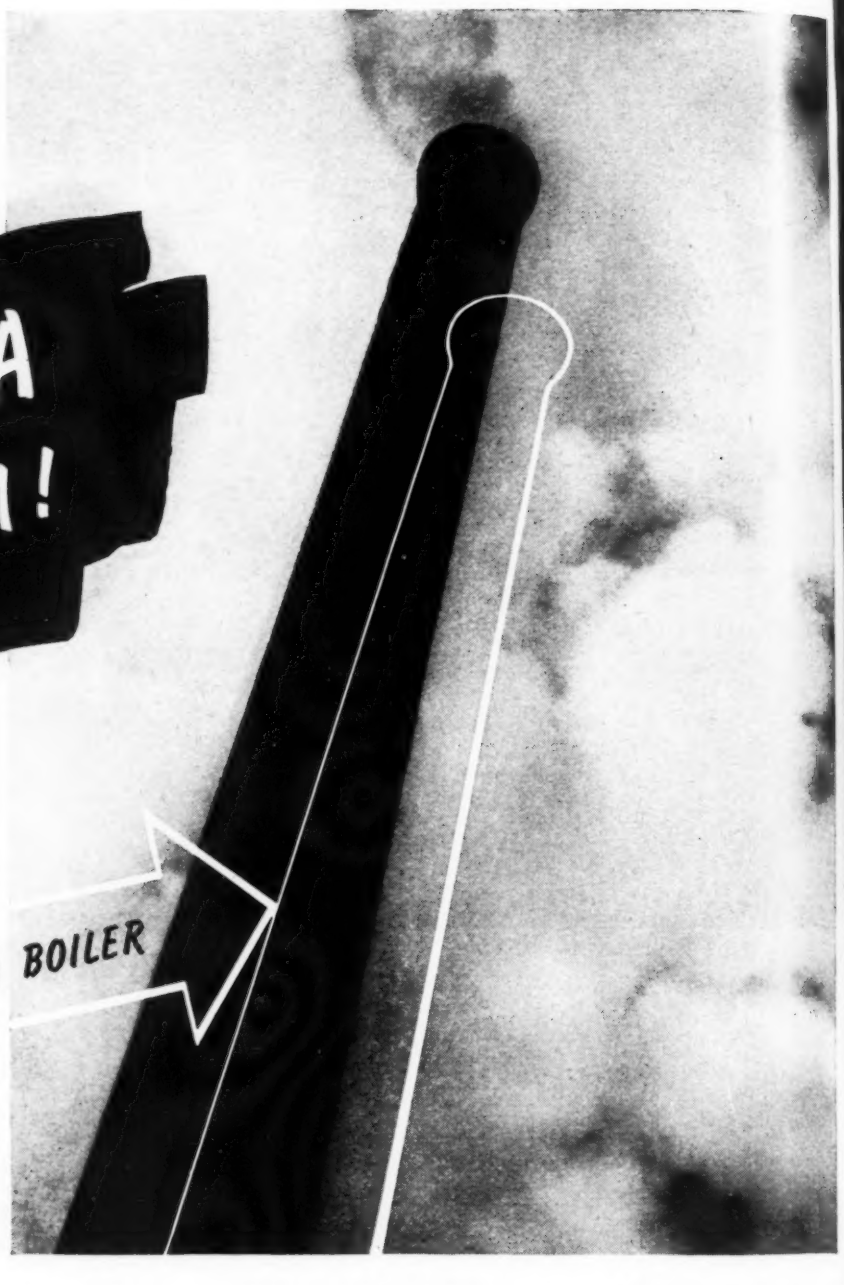

EXTRA STEAM!

...WITHOUT AN EXTRA BOILER

With the war-time demand for more steam, many owners of Edge Moor Water Tube Boilers have increased the output of their present boiler equipment by installing Edge Moor Water Walls, pre-heaters, economizers, etc. As a result, steam output has been increased as much as 200% and steam costs have been materially reduced!

Edge Moor offers a complete service from design to installation of all steam generating units including: Boilers, Superheaters, Water Walls, Economizers, etc. Call in an Edge Moor engineer today! Have him show you what can be done to boost *your* steam output —and cut *your* costs.

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STEAM GENERATING EQUIPMENT

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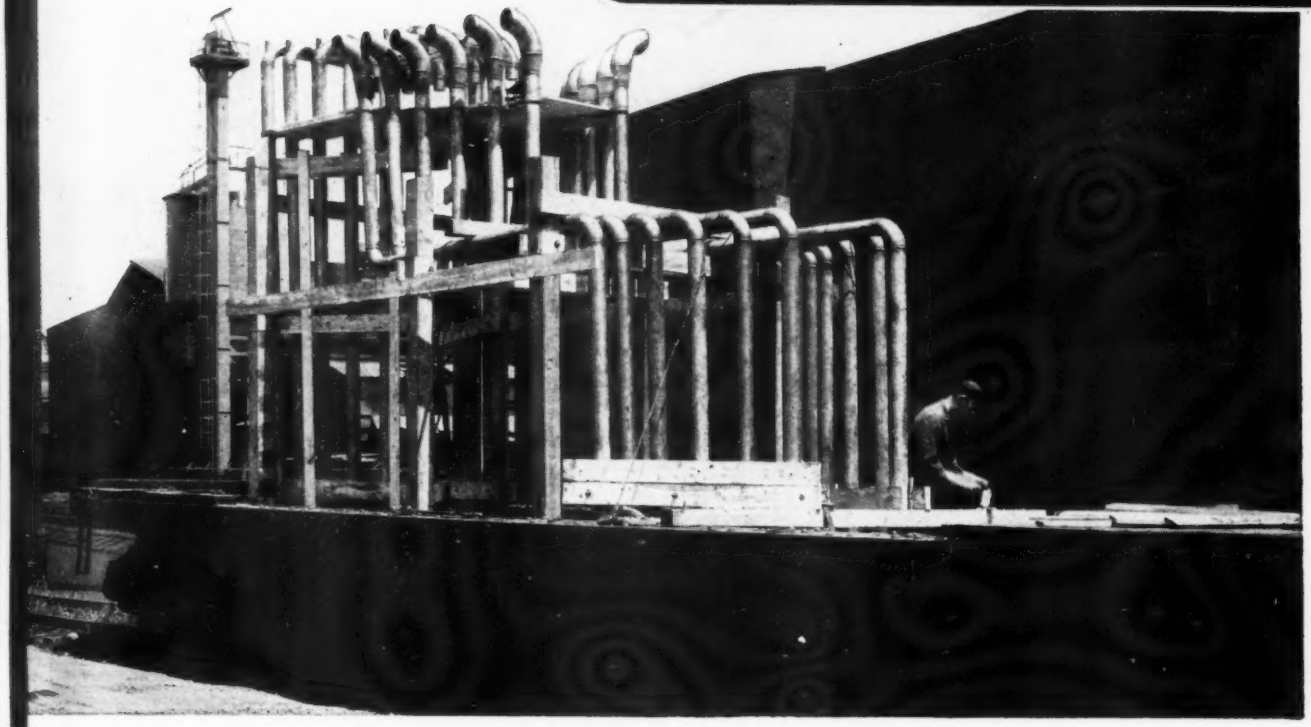
FASTER PRODUCTION
EASIER INSTALLATION
GREATER ECONOMY
ASSURED QUALITY



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PRE-FABRICATED PIPING

PRE-FABRICATING piping into subassemblies as large as shipping facilities and installation space will permit, saves time both in the shop and in the field. It assures uniform quality and utmost economy through unified control of all production operations.

The photograph above shows a subassembly of pre-fabricated stainless piping to be used in a synthetic rubber plant. Consisting of 570 feet of I.P.S. straight pipe and 108 pieces of standard I.P.S. welding reducers and welding elbows, the entire assembly is made of stainless steel number 347.

Pittsburgh Piping and Equipment Company has had over forty years successful experience in research, engineering and development in the fabrication of single units or complete piping systems for central stations, chemical and process plants, plus complete facilities for bending, welding, machining, heat treating, stress-relieving . . . experienced personnel for fabricating and erecting . . . a well equipped metallurgical laboratory to constantly check materials and operations during field erection as well as fabrication. Dimensional accuracy, uniform quality, and dependability, are thus assured in every type of piping installation.

Let our engineers help you plan improvements, additions, or complete new plants. Contact our nearest representative or write us direct. There is no obligation.

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NOT JUST ONE BUT ALL . . Every Liberty ship that sails the seas is K & M equipped. We at K & M get real satisfaction from knowing that our 65 years of experience enables us to produce *better* pressure and fluid control specialties . . . and to produce them *faster.* Inquiries invited. *Write for Catalog No. 66.*

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My Business Maintains High Accuracy Standards, That's Why In Measuring Valuable Stored Liquids, We Rely On . . .

LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"

100% automatic—these tank gauges insure accurate, trouble-free readings whenever required. No pumps, valves, or auxiliary units required to read them. Models available so that readings can be taken remotely from or directly at the tank. Remote reading types utilize balanced hydraulic transmission system which completely compensates for temperature variations on communicating tubing. Accuracy unaffected by specific gravity of tank liquid.

Approved for gauging hazardous liquids by Underwriters' Laboratories and other similar groups. Models available to automatically control pumps, motors, signals or other devices for maintaining minimum or maximum liquid levels.

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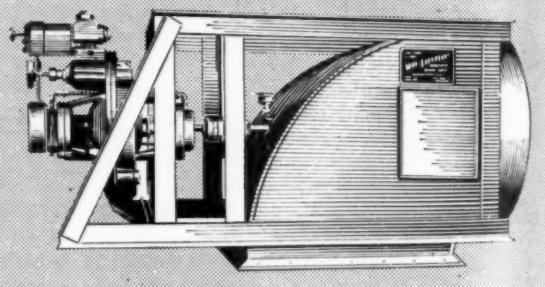
Another **WING** *Product*



WING-SCRUPLEX TURBINE-DRIVEN EXHAUSTERS

Wing Turbine-Driven Exhausters are available to the chemical and process industries, or to any industries where it is important to use this method of exhausting explosive vapors, gases, fumes or powders. Wherever these combustible vapors must be exhausted, the Wing Turbine-Driven Exhauster will eliminate hazards of explosion and fire from sparking motors on electrically driven exhausters. Because they are operated by steam, there are no hazards from short circuits or sparks as there might be if electrically driven motors were used.

L. J. Wing Mfg. Co.

West 14th St. & 7th Ave., New York, N. Y.—Factories: Newark, N. J.

ONE of FOUR

Surface Condensers
Totaling 122,000 Square Feet

Typical of larger surface condensers designed and built by Lummus is this 36,000 square foot unit for a well-known public utility. Precision workmanship in the Lummus Company plant will facilitate easy and accurate assembly in the field.

All Lummus condensers are equipped with air ejectors designed and built by Lummus.

DESIGN FEATURES
LUMMUS SURFACE CONDENSERS

- Streamlined Tube Layout
- Internal Air Cooling Section
- Deaerating Hotwell

RESULTING IN —

- Minimum Pressure Drop
- Minimum Condensate Depression
- Minimum Condensate Oxygen Content
- Minimum Air Ejector Steam Requirements

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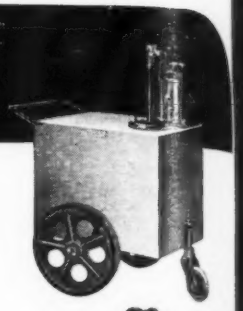
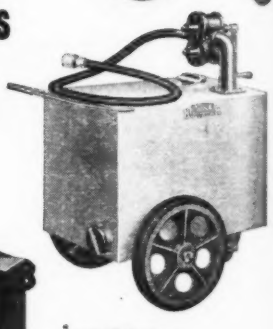
LUMMUS

MODERNIZE WITH WHEEL TANKS



TODAY'S high production schedules demand efficient lubrication to prolong machine life . . . to do better work . . . to increase life of tools. To do this more easily and with better control, many firms place the responsibility of oil delivery in the hands of one man . . . use wheel tanks to simplify the job . . . and do it without mess or oil waste. To help you, Bowser makes numerous types of wheel tanks . . . models with quart or gallon self-measuring pumps . . . non-measuring types for drawing dirty oils from machine sumps and transporting to a central filter . . . double compartment models for dirty oils and clean oils . . . models with pressure type filter for cleaning oils at the machine . . . hand operated models . . . power operated models . . . etc. Capacities from 65 to 90 gallons permit emptying shipping drums, releasing them for immediate re-use. Let us tell you how Bowser wheel tanks can help you.

★ SAVE TIME
★ SAVE LABOR
★ SAVE LIQUIDS
★ RELEASE SHIPPING DRUMS



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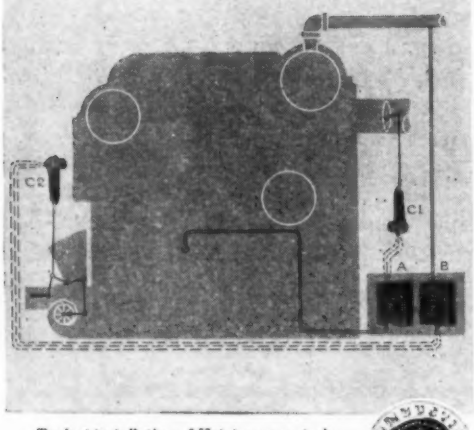
FORT WAYNE BOWSER INDIANA

LIQUID CONTROL SPECIALISTS – SINCE 1885

METERING · DISPENSING · STORING · LUBRICATING · FILTERING · DISTILLING

Dependable Automatic Boiler Control

AT SURPRISINGLY LOW COST . . . BY HOTSTREAM



Typical installation of Hotstream controls on stoker-fired industrial steam plant. (A) Dampertrol, (B) Steptrol, (C1 & 2) Electric Pistons.

Hotstream engineers designed this line of Combustion Equipment to provide low-priced, dependable boiler control at a cost low enough to be within the reach of every plant, large or small. Results are comparable to those obtained from elaborate, expensive systems—at but a fraction of the cost. Listed as essential fuel-saving devices by W.P.B., they are available now *without priority* . . . Typical installation at left shows how Hotstream Dampertrol (A) regulates uptake damper through Fast Stroke Electric Piston (C1) from changes in overfire draft, while Hotstream Steptrol (B) controls fuel and air supply through Electric Piston (C2) from changes in steam pressure.

HOTSTREAM ALSO OFFERS:

THERMOGAGE . . Electric flue-gas-temperature indicator.

DRAFT GAGE . . Overfire, last-pass, or uptake—draft indicator.

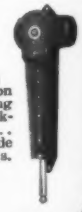
AIR-PRESSURE GAGE . . Indicates undergrate pressure or pressure in air-conditioning ducts and filtering systems.

DRAFT-O-STAT . . Barometric draft control for domestic, commercial and industrial installations.

AGENTS: Several attractive territories still open. Write for complete literature.

Hotstream Dampertrol . . . control for Electric Piston operating from draft or air pressure.

Hotstream Steptrol, control for Electric Piston operating from steam pressure.



Hotstream Electric Piston for regulating dampers, stokers . . valves . . etc. . . . Made in 3 speeds.

Combustion Equipment Division

THE HOTSTREAM HEATER COMPANY

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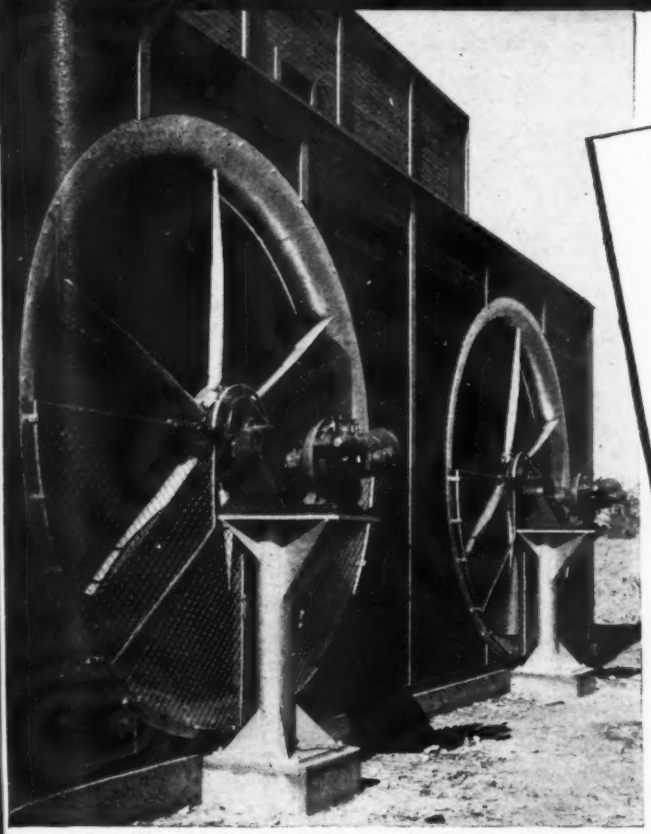
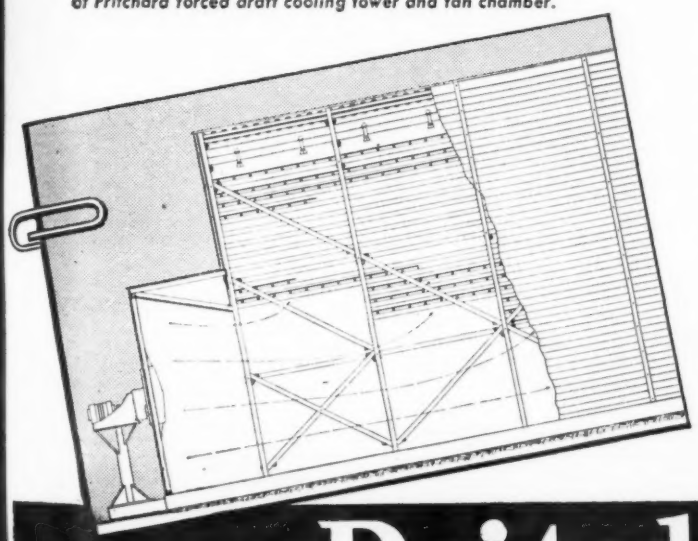
LOW COST COOLING
FOR A LONGER PERIOD OF TIME



View of fan chamber housing two Pritchard light weight non-corrosive fans. Below, drawing showing construction of Pritchard forced draft cooling tower and fan chamber.



Pritchard
COOLING TOWERS
- **Cost Less to Operate**
- **Increase Cooling Efficiency**
- **Prolong Service Life**

SPREAD your cooling costs over a period of five years and you will readily see how PRITCHARD TOWERS give you *low cost cooling.*

Low pumping heads, large pipes and low pressure sprinklers keep power costs down. Counter flow design provides cool dry air to contact coldest water, thus producing lowest possible temperature and increasing cooling efficiency.

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PRITCHARD TOWERS are designed with that extra margin of structural safety that not only withstands ordinary load stresses, but prolongs service life.

Delivery of PRITCHARD COOLING TOWERS is facilitated through standardized sectional construction. A complete line of stock is maintained at all times, ready for immediate shipment.

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TULSA
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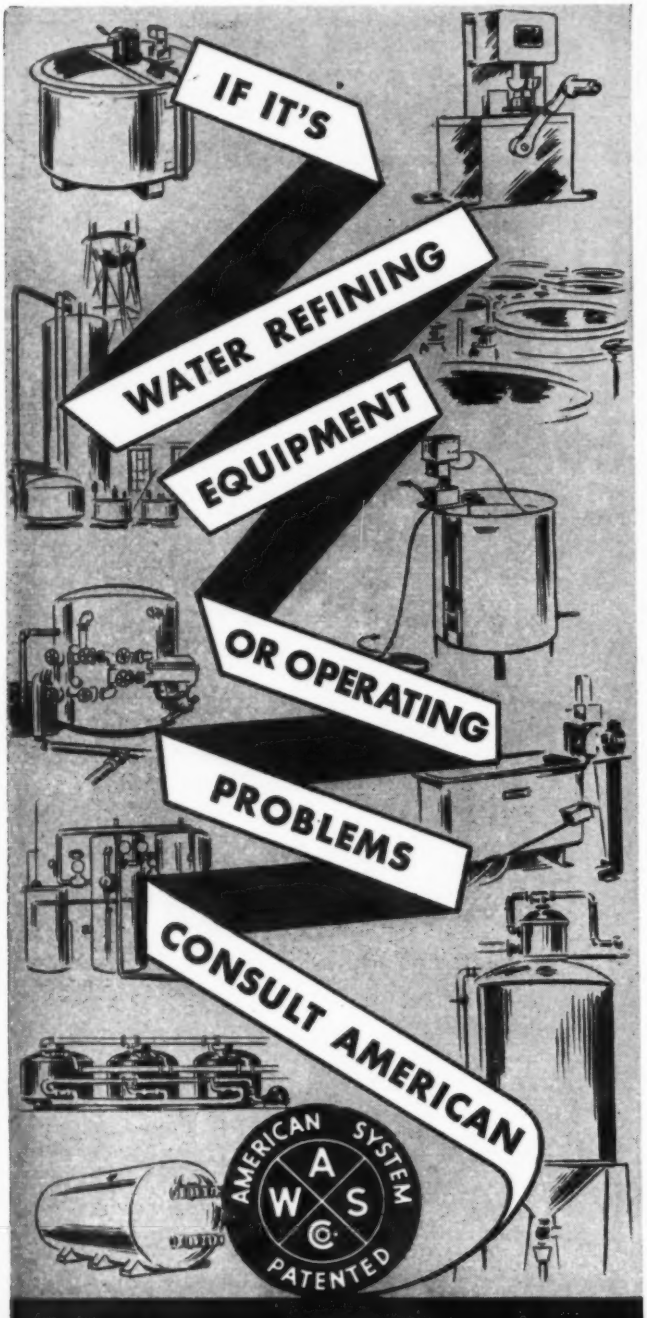
ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers



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FILTERS OF ALL TYPES *and* CAPACITIES...GRAVITY...PRESSURE

SOFTENING SYSTEMS—ALL TYPES *and* CAPACITIES—
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EQUIPMENT for **REMOVAL** of IRON . . . TASTES . . .
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Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

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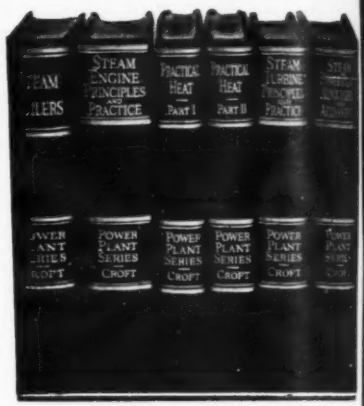

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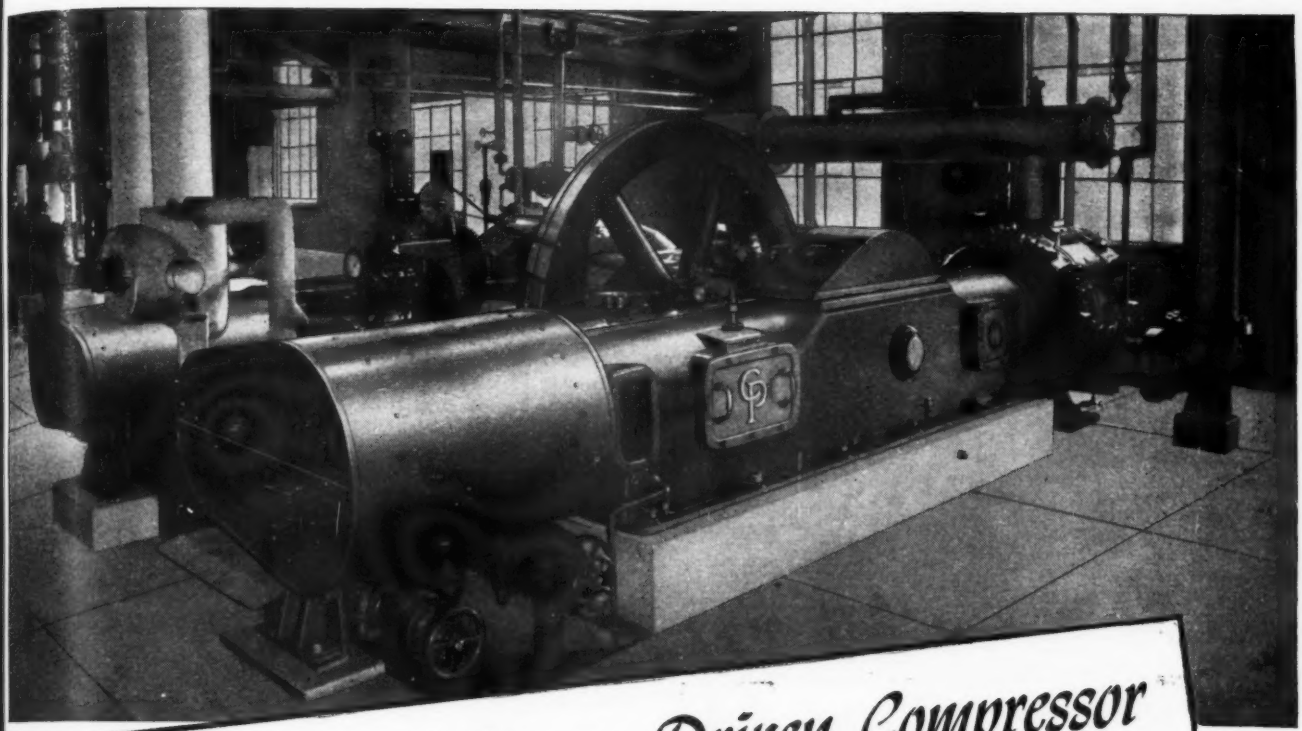


Another CP Steam-Driven Compressor
GUARDS AGAINST POWER FAILURE

This CP Horizontal Duplex, Steam-Driven Compressor, installed in a war plant is safeguarding production against shutdown through power failure of the synchronous motor-driven CP Compressor installed with it.

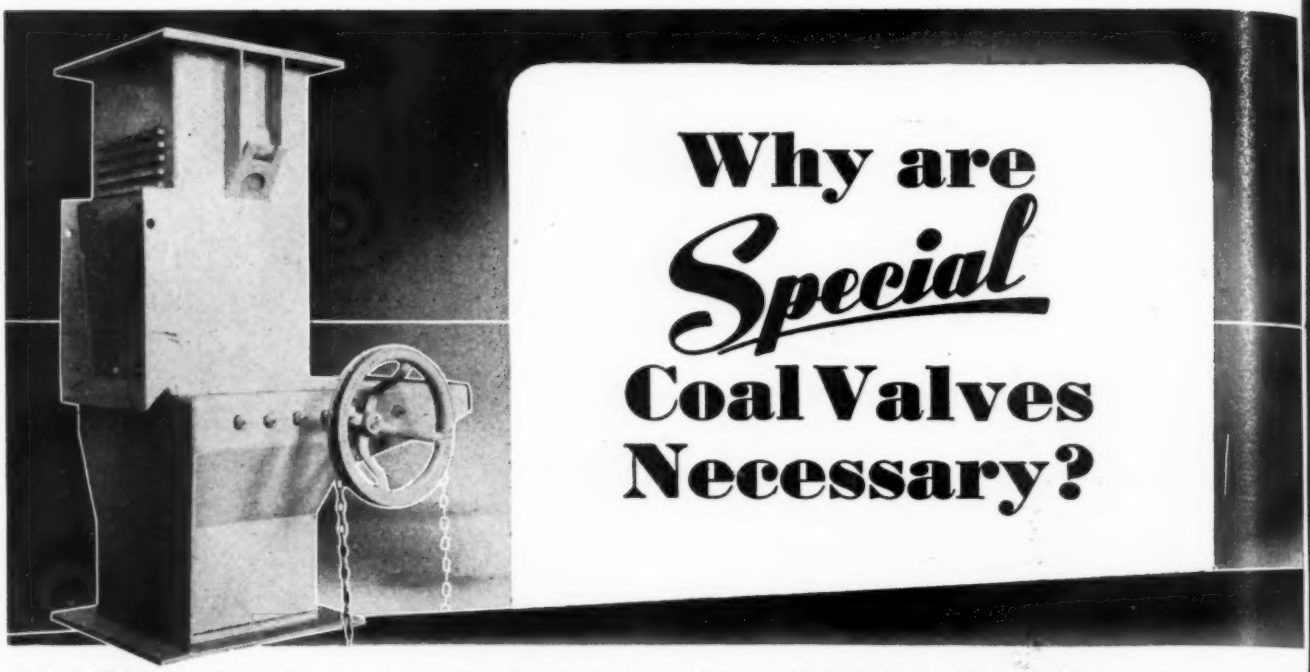
CP Steam-Driven Compressors are playing their part in the war effort . . . protecting vital war plants against interruption of air supply due to power line failure . . . efficiently utilizing boiler capacity where it is more plentiful than electrical current . . . providing exhaust steam where needed for heating or process work.

CP Steam-Driven Horizontal Duplex, Two-Stage Compressors are ideal for large and medium-size plants. Capacities range from 400 to 6600 c.f.m., 100 to 125 pounds air pressure with steam cylinders available for a wide range of steam conditions. Other sizes in single and multi-stage design for lower and higher pressures. Write for literature.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
(Hicycle...Universal)
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES



Why are *Special* Coal Valves Necessary?

• Coal Valve requirements vary to such a degree that special consideration must often be given in supplying valves that will fit the purchaser's plant conditions. For example the S.E.Co. Coal Valve illustrated provides not only an effective shut-off gate, but also an emergency gate, enabling operators to divert the coal in case of bunker fires. A Poke-hole is also included.

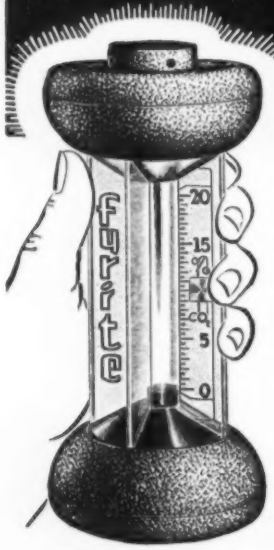
Consult S.E.Co. on *your* special problems *now* . . . full information on S.E.Co. equipment will be sent on request. Address inquiries to Stock Engineering Company, 9805 Theodore Avenue, Cleveland, Ohio.

STOCK
★ ENGINEERING CO. ★

CONICAL Non-Segregating Coal Distributors — **S.E.Co. Coal Valves and Coal Scales**

ARE YOU WASTING *Precious Fuel Up the Stack?*

THE *PORTABLE*
FYRITE
CO_2 ANALYZER
EXPOSES STACK LOSS *INSTANTLY!*



$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

Getting all the heat possible from your fuel? *Be sure*—use the FYRITE "Orsat" CO_2 Analyzer. It makes accurate flue gas tests easy—instantly exposing percentage of fuel wasted. The FYRITE is simple, rugged, cold-weather proof—has no valves, clamps or leveling bottle; no glass parts or batteries. More than 8000 FYRITES are in service.

OXYGEN ANALYZER designed on same principle available soon. Write for particulars.

RETURN THIS COUPON FOR BULLETIN 340 *on FYRITE "Orsat". Also learn how to get immediate delivery under priority regulations.*

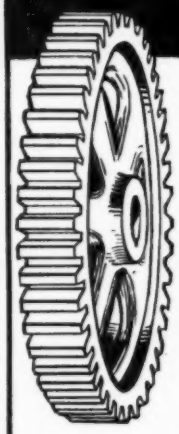
Name

Address

City State P

BACHARACH
Industrial Instrument Co.
7000 BENNETT ST.
PITTSBURGH, PA.

Gears
PRECISION CUT
Any Material-Any Quantity



Our large modern plant is ready to serve you whether you need a single gear or a production run. We have the facilities and the equipment for fast, accurate, low cost production. We also produce generated tooth racks in any desired length, from 4 to 16 diametral pitch; 14½ or 20° teeth. Precision Surface Grinding. Sprockets for Roller Chain. You'll find it advantageous to entrust your work to us.

ASK *for* ESTIMATES

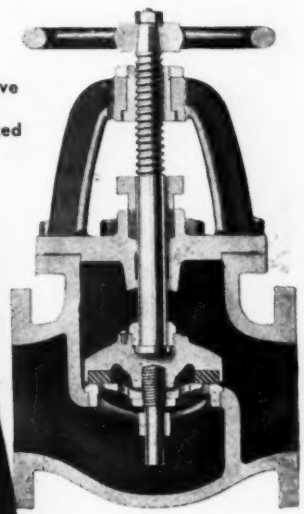
Industrial
Cut Gears · Cut Sprockets

INDUSTRIAL GEAR MFG. CO.
4543 VAN BUREN STREET CHICAGO 24, ILLINOIS

Does Your Assistant Know HOW TO SELECT A VALVE?

Today, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you allow your assistant to specify a valve for that all-important line, make sure he knows what type is needed.

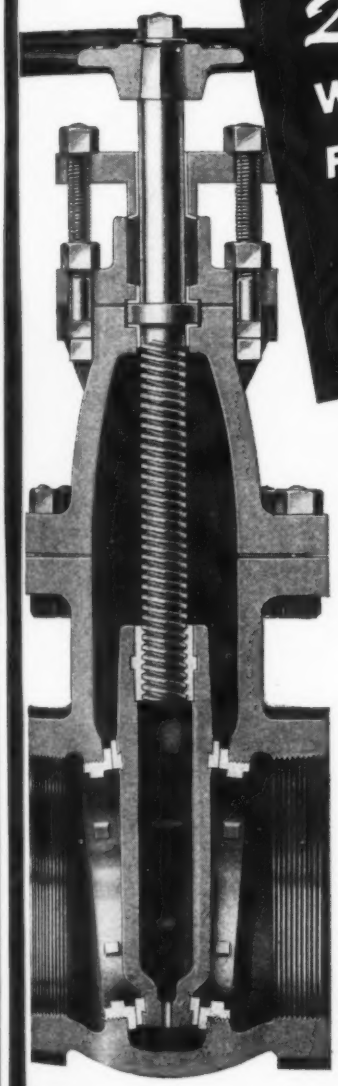
Here is the answer to a frequently-asked question on valve selection, taken from the files of The Kennedy Valve Manufacturing Co. Other questions will be considered in succeeding advertisements in this series.



Globe valve with bronze-faced disc

Question:

WHY ARE THERE SO MANY DIFFERENT TYPES OF VALVES?



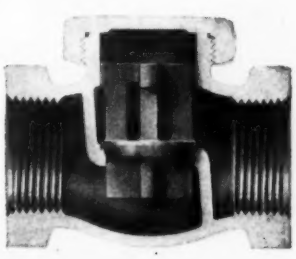
Answer:

Because no single design of valve is suitable for all applications . . . each is best for certain jobs. Double-disc gate valves, for example, are preferable where liquids containing grit are to be handled. Wedge gate valves are recommended for gummy liquids and are preferred for steam service by some engineers. Both types are better than globe valves for lines on which it is important to minimize resistance to flow. Globe valves should be chosen for throttling service and where the valve is to be operated frequently. Outside-screw-and-yoke gate valves provide visual indication of disc position but require headroom. Non-rising stem gate valves are not recommended for corrosive fluids because the stem threads are in contact with the substance handled. Lift-check rather than swing-check valves are preferred for a pulsating flow.

GIVE THE VALVE A CHANCE . . . SELECT IT FOR THE JOB. IF YOU DON'T KNOW WHAT VALVE TO SPECIFY, ASK YOUR DISTRIBUTOR OR WRITE TO THE MANUFACTURER.

If you have a valve selection problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

Iron body wedge gate valve



Lift check valve

KENNEDY VALVES • PIPE FITTINGS • FIRE HYDRANTS
THE KENNEDY VALVE MFG. CO. • ELMIRA, N. Y.

• • • • TRAP THE ICE SABOTEUR THAT RUINS PNEUMATIC TOOLS

● Moisture condensed in compressed air may freeze-up pneumatic tools and halt production . . . or it may wash out lubrication and cause damage to parts that are hard to replace.

Trap this sabotage by using a NIAGARA AERO AFTER-COOLER for your air compressor. It will produce compressed air that contains only ½ to ¾ as much moisture as air cooled by ordinary conventional equipment. At the same time it will save 95% of your cooling water cost; pay for itself quickly.

The NIAGARA AERO AFTER-COOLER prevents water or corrosion damage to pneumatic equipment, prevents shut-down of work caused by pneumatic tools freezing up, reduces the harmful moisture content in paint sprays, saves money for air and gas compressor users.

Write for details of these benefits.

NIAGARA BLOWER CO.

General Sales Office: **6 E. 45th St., New York 17, N.Y.**

District Engineers in Principal Cities

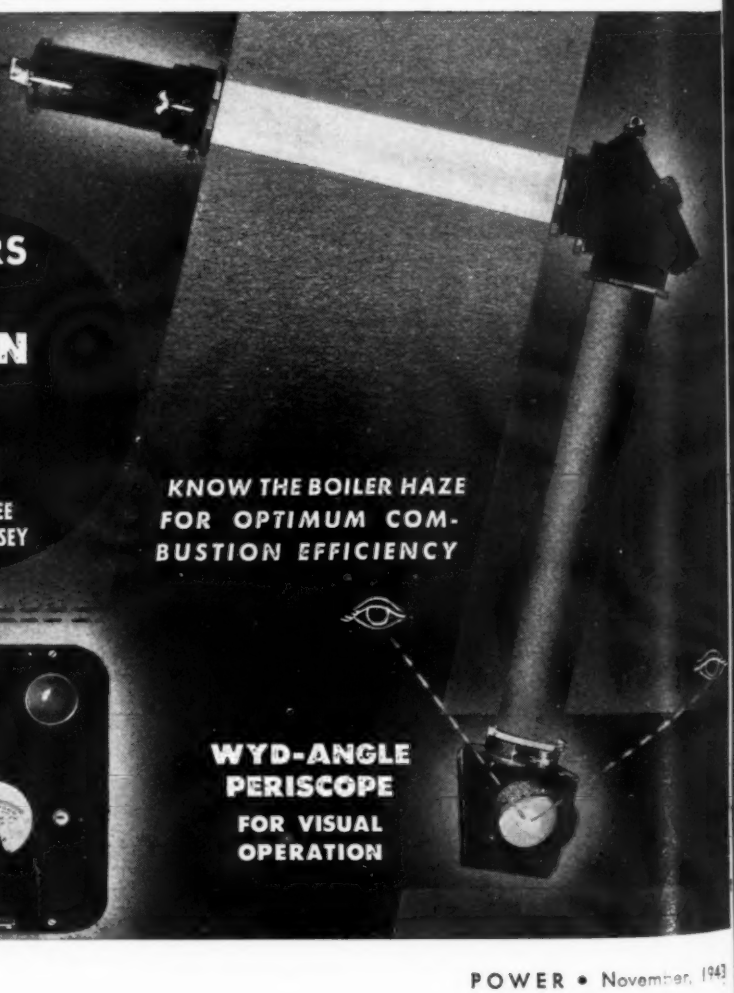
NIAGARA *INDUSTRIAL* **COOLING • HEATING • DRYING HUMIDIFYING • AIR ENGINEERING** *EQUIPMENT*

ESS

INDICATORS, CONTROLLERS and RECORDERS for SMOKE & COMBUSTION

SPECIFIC GRAVITY • TURBIDITY • FLAME FAILURE • INDUSTRIAL and SAFETY APPLICATIONS

ESS INSTRUMENT CO. FORT LEE NEW JERSEY



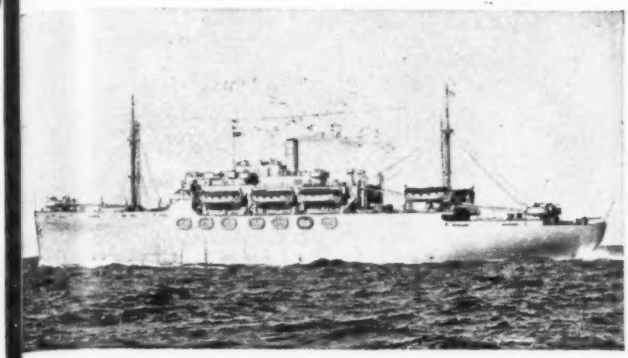
KNOW THE BOILER HAZE FOR OPTIMUM COMBUSTION EFFICIENCY

ELECTRONIC HAZEGAGE
FOR AUTOMATIC SIGNAL OPERATION

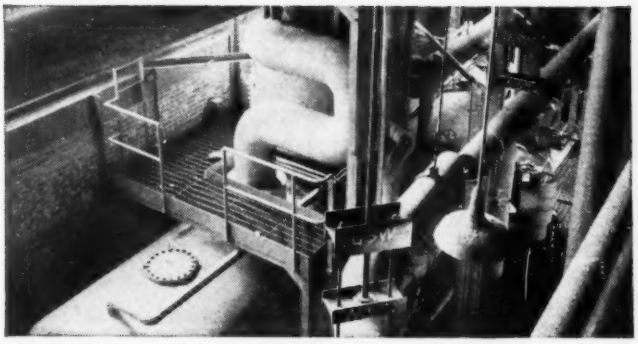
WYD-ANGLE PERISCOPE
FOR VISUAL OPERATION

WRITE FOR CATALOG P

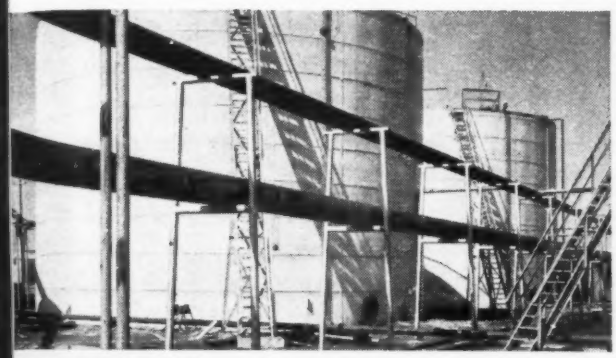
IN ALL FIELDS...



MARINE What comes first in ship insulation—the material . . . men to apply it . . . the right insulating method for each problem?



POWER Is there a way of insulating that will help power engineers and plant executives to increase production through better installations?



OIL REFINING Refineries *must* maintain close control over a multitude of different temperatures. What about one line of insulation products that meets all requirements from 0° to 1900°?

HEATING, AIR CONDITIONING What? When? Where? How can heating engineers, in America's many industrial areas solve their insulation problems with the least delay?

MEN, MATERIALS, METHODS

as one insulating service

Men? Materials? Methods? One without the other two . . . two without the third . . . is *not* the way to get efficient insulation.

Be sure of all three efficiency factors . . . MEN, approved applicators who are specially trained in industrial insulations—MATERIALS, all types of industrial insulations in one complete line—METHODS, ways for doing the job that have been proven in the field.

Ruberoid provides *all three* . . . as one service backed by years of meeting the insulation needs of many industries.

Call in a Ruberoid engineer. Let him tell you more about—and how to get—Ruberoid Service for *your* insulation problems.

The RUBEROID Co., 500 Fifth Avenue, New York 18, N. Y.

RUBEROID INSULATION PRODUCTS

Imperial Asbestos Insulation
85% Magnesia Insulation
Air Cell Pipe Covering
Woolfelt Pipe Covering
Sponge Felt Pipe Covering
Mineral Wool Insulations
High Temperature Insulations
Low Temperature Insulations
Asbestos Papers & Boards
Insulating Cements

MATERIALS, MEN, METHODS—all 3 with

RU-BER-OID THERMAL INSULATIONS

Service to Industry since 1886 . . . Genuine **RU-BER-OID** *Roofings and Building Products*

Until the Uniforms can be put away...

Quaker will keep on giving the right-of-way to all orders coming from the Government direct or from those companies requiring Industrial Rubber Products to complete the War Orders which they have.

Quaker is as anxious as anyone to turn production back to take care of the needs and demands of the civilian trade. The Allied Forces in their combined drives, are dealing some very telling effects. Events are on the swift move. Each day is counting in a big way. Perhaps the final score will be settled in a much shorter time than many of us anticipated, and bring that day of complete Victory, which we all know will eventually arrive.

Our entire group of friends with whom we do business, almost without exception, recognize and appreciate what Quaker is doing to keep Industrial Rubber Goods flowing to them, and we deeply appreciate their spirit of cooperation, and are eagerly looking forward to that day when we can give the service that normal conditions permit.

QUAKER
INDUSTRIAL RUBBER PRODUCTS

Quaker was founded in 1885 with the keynote of supplying quality merchandise to the trade. Our growth has been steady throughout the years . . . today, we have thousands of satisfied customers, many of whom have been buying their rubber products from us for a quarter century and longer.

With our 9,001 various items of Belting, Hose, Packings and Moulded Parts, Quaker offers a complete line to serve the trade with whatever may be desired in Industrial Rubber Products.

Even in these strenuous days—if there is a way to get it done, Quaker will do it.

BUY MORE WAR BONDS

QUAKER RUBBER CORPORATION
PHILADELPHIA 24, PA.
NEW YORK 7 CLEVELAND 15 CHICAGO 16 HOUSTON 1

Western Territory
QUAKER PACIFIC RUBBER COMPANY
SAN FRANCISCO 5 LOS ANGELES 21

A Name To Remember Post-War

GATX GENERAL AMERICAN
PLATE & WELDING DIVISION
PLANT AT SHARON, PA.

NOW AT WORK 100% FOR VICTORY

Steel plate fabricators

Manufacturers of Class I pressure vessels and all other classes of welding

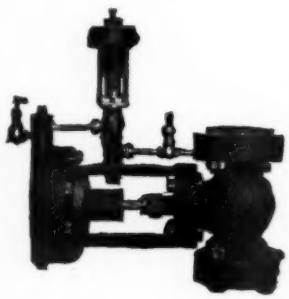
Complete X-ray and annealing facilities

Completely equipped department for field erection

Plate and Welding Division
GENERAL AMERICAN TRANSPORTATION
CORPORATION
SHARON, PA.

Squires CLASS E PUMP GOVERNOR

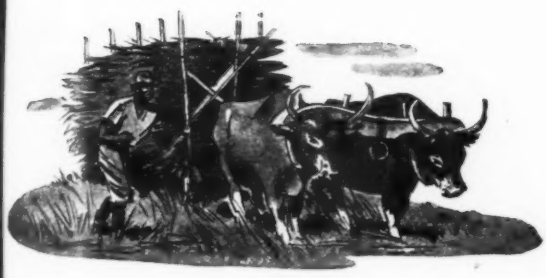
Is simple in construction and fulfils all conditions required of a pump governor. Real service is expected from every cash outlay for mechanical equipment, and Squires Steam Specialties are a receipt in full for such investments. It's worth your while to inquire about them.



Squires Class E Pump Governor

Described in Catalogue A-11. Sent upon request

The C. E. Squires Company
East 40th St. and Kelley Ave., Cleveland, Ohio



Case #750 - It Takes Steam to Produce Sugar

The story of how Bigelow-Liptak engineering provided a good neighbor nation with a bagasse furnace enclosure to get increased mill capacity and provide the United States with more sugar when other sources of supply were cut off.

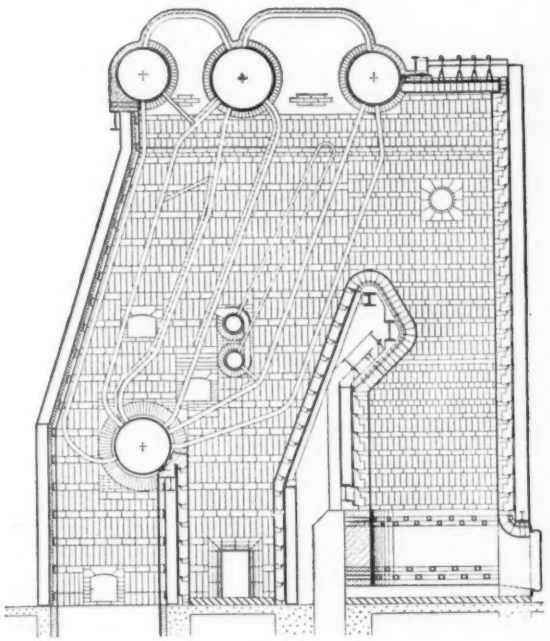
EARLY IN 1942 our sugar problem was critical. War had almost cut off our usual large imports from Hawaii, Puerto Rico and Cuba. Our supply would henceforth have to come from sources which had previously furnished only a small part. This meant extensive and hurried expansion in mills and sugar producing equipment.

One of these mills was located on the west coast of the Sierra Madre mountains down in Mexico. To secure increased capacity quickly, a new boiler would be required. The furnace problem would be difficult due to the burning of bagasse which is a very wet sugar-cane residue.

To aid the distilling process and the mixing of fuel gases with air for combustion, a *Ward* type furnace, with special provisions for admitting pre-heated air, would be used. Consequently, proper arch construction for directing the gases to the heating surface in this boiler would be of utmost importance. The contour and gas passage openings would have to be designed for the quality and quantity of bagasse to be burned. Air-tight wall encasements with minimum thermal losses and low maintenance would be necessary for continued heat efficiency and low operating cost. The inaccessible location of the mill added to the need for a low maintenance enclosure.

The Solution

In record time a Bigelow-Liptak furnace enclosure was making it possible for this good neighbor's mill to supply the United States with increased quantities of sugar. Furnace design was of utmost importance. The adaptation of complete suspended construction and the proper recovery of pre-heated air and its admission to the furnace were important Bigelow-Liptak contributions.



The Liptak Single Suspension Arch is ideally adapted to the unusual arch arrangement required by this Ward type bagasse furnace. The overhanging arch contour was easily provided with a few standard Liptak tile shapes in such a manner as to make an otherwise complicated construction simple. Here again the advantages of unit tile suspension are apparent, not only in erection but also in repair. Liptak radial tile are adapted over firing openings as well as around large access doors. Bigelow sealing arches at the front steam drum, together with a Bigelow expansion joint provide for maximum air tightness at this vulnerable point. A real saving in the cost of the boiler enclosure was made possible by applying a 3" Bigelow Budget Wall for the rearmost sloping baffle. This also considerably reduced the side wall area.

Bigelow-Liptak Heavy Duty 9" Double Suspended Walls are ideally adapted to the primary combustion chamber. Offset tile construction assures air-tightness. Double suspension design provides for ease of erection and repair. The sloping wall back of the combustion chamber as well as the bridge wall are 7" construction. Convection areas where service is not severe utilize thin Bigelow Budget Walls. These walls were made air-tight by the exclusive Bigelow method of applying insulation which requires no outer casing of any kind.

Is Yours a Special Enclosure Problem?

The significance of this problem and its complete solution by Bigelow-Liptak is much greater than any resemblance it may have to your own problems. It serves to demonstrate the value you may receive by taking your special enclosure problem to Bigelow-Liptak regardless of its type or size. Bigelow-Liptak's wide experience in designing enclosures includes every type of problem having to do with thermodynamics, ceramics and mechanics of materials. With Bigelow-Liptak there is no standard or set solution for every case. Individualized engineering, based on years of experience and sound engineering principles, is applied towards giving the customer the best and most economical solution to his particular needs. Our policy is to give first and foremost consideration to the needs of the user.

BIGELOW LIPTAK Corporation

Unit-Suspended Walls + Arches

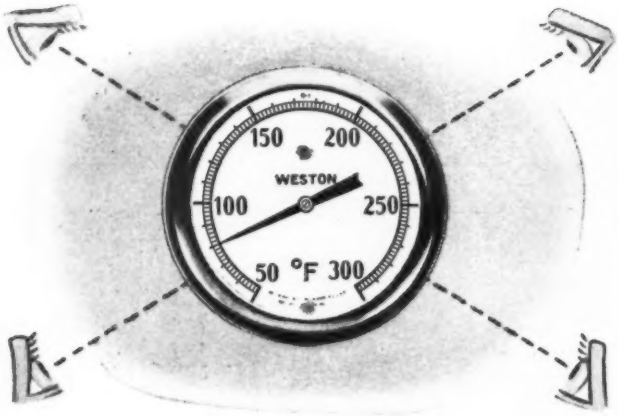
The Key to Operating Economy

BIGELOW-LIPTAK CORPORATION
DIVISION A. P. GREEN FIRE BRICK CO.
330 Curtis Building
DETROIT

Free Catalogs

Our engineering staff will be glad to send you interesting catalogs or tell you how you could secure increased service and economy by the use of Bigelow-Liptak Unit-Suspended walls and arches in your plant. Write today.

THE "EYES" HAVE IT...



Readability is only one advantage of the *All-Metal* TEMPERATURE GAUGE

The WESTON gauge-type thermometer is *far more readable.* But the big point is that *seein's believin'* whenever you read a WESTON. Because its high initial accuracy (1% over the entire scale) is maintained over long periods of time. The reason is... even the temperature element in the WESTON is all-metal! There is no gas, no liquids, no fragile parts. Thus it can withstand vibration or other mechanical abuse without damage or without affecting its accuracy. It's easier to install, too, and no corrections are necessary for capillary or elevation.

Booklet describing these rugged and dependable thermometers, including types, stem lengths, prices, etc., gladly sent on request. Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, N. J.

WESTON

ALL-METAL TEMPERATURE GAUGES

SAFE-LINE

WIRE ROPE CLAMPS

Write for details of this—the only PERFECTED wire rope clamp on the market. Used by the Armed Forces and thousands of industries.

NATIONAL PRODUCTION COMPANY

4523 ST. JEAN AVENUE DETROIT 12, MICHIGAN

ENGINEERED TO CUT COSTS

The high efficiency rating of SCV Pumps is not an accident—it is the result of over 30 years' *specialized experience,* modern plant equipment and highly skilled craftsmen. Thus the lower maintenance and operating costs of Economy Pumps are a measurable gain, assured by precisely engineered features, such as:

1—High motor mounting—above floor splash and dirt,

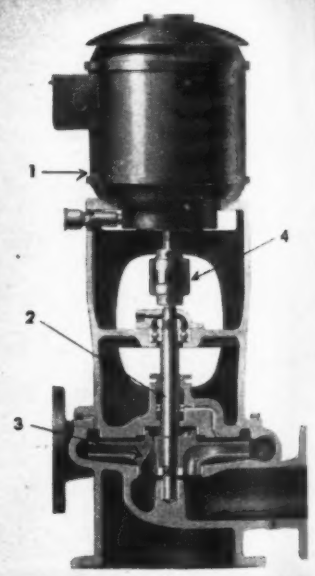
2—Accessibility—complete rotor removable without breaking pipe connections,

3—Smooth operation—impeller spins between two bearings,

4—Flexible coupling—accessible stuffing box,

5—Standard motor—avoids prolonged shutdown as any stock motor is usable,

6—Handles all clear liquids—10 to 500 GPM.



Write for New Pump Data Book

Indispensable to Plant Executives and Engineers. Sent Free. Simply write for copy on your letterhead.

ECONOMY PUMPS, Inc.

HAMILTON, OHIO

"DIFFICULT" FLUIDS *Always Obey*

with Walworth

LUBRICATED PLUG VALVES

Because:

1. The lapped surfaces of the valve are "pressure sealed" when the valve is in either the open or closed position.

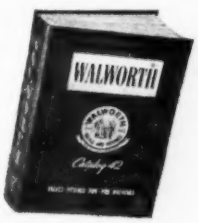
2. "Pressure seal" is accomplished by forcing lubricant under high pressure to the bottom of plug as well as into a grooving system which completely encircles the ports.

3. Lubricant not only seals valve against leakage, but also reduces friction between plug and body, permitting easy operation.

4. Coating of lubricant protects plug and body of valve against contact with line fluid, thus combatting corrosion.

Walworth Lubricated Plug Valves are made in a full range of sizes, from ½" to 24", from vacuum to 5,000 p.s.i. For complete information, write for Circular 67.

SEND FOR CATALOG



You'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 East 42nd St., New York 17, N.Y. Dept. N5.

BOSTON WORKS
KEWANEE WORKS

WALWORTH
valves AND fittings

WALWORTH ★ VALVES AND FITTINGS ★ ESTABLISHED 1842

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

SHOUTS A WARNING *Before* DAMAGE OCCURS!

MAGNETROL PATENTS PEND. TRADE MARK

FLOW ALARM

● Used on boiler feed lines or cooling water lines to turbine bearings, the Magnetrol Flow Alarm sounds or flashes a warning when flow starts, stops, or drops below a predetermined level. The Flow Alarm is actuated by *rate of flow* only, it is not affected by changes in pressure.

Switch action is based on a foolproof magnetic principle—there is no linkage between moving parts of valve and switch. There are no bellows, no packing boxes, diaphragms or electrodes to fail or cause trouble.

Magnetrol engineers are prepared to help you determine applications in the Power field for the Magnetrol Flow Alarm. *Write today for full data on engineering details, specifications, sizes, applications, etc.*

MAGNETROL, INC.
673 North Orleans Street • Chicago 10, Illinois
A DIVISION OF FRED H. SCHAUB ENGINEERING CO.

BROWNELL BOILERS

For 85 years this company has been making good boilers. We invite comparison on quality, price, and delivery of various types and sizes of fire tube boilers from 3 H. P. to 250 H. P.

Write us for illustrated bulletins.

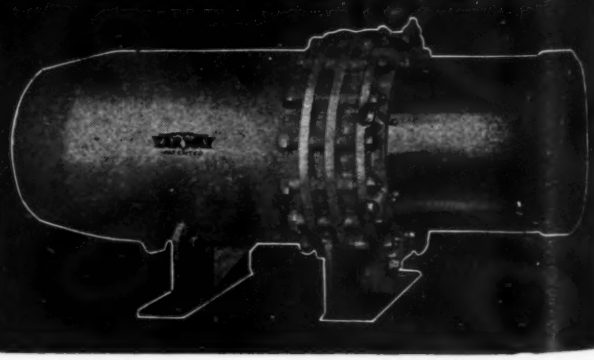
THE BROWNELL COMPANY • The World Over • since 1858 • DAYTON, OHIO, U.S.A. •

YARWAY GUN-PAKT EXPANSION JOINT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box. Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1908.

•

YARNALL-WARING COMPANY
100 Mermaid Ave., PHILADELPHIA 18, PA.



AN IRON HAND . . . *in a Velvet Glove*

12 millionths of an inch is tolerance limit for work on this Ultra-Lap Machine that produces optically flat metal surfaces. A compactly designed Morse Roller Chain drives the front spindle—delivering a power flow that remains necessarily constant and "precise"—because there's no possibility of slip, regardless of load.

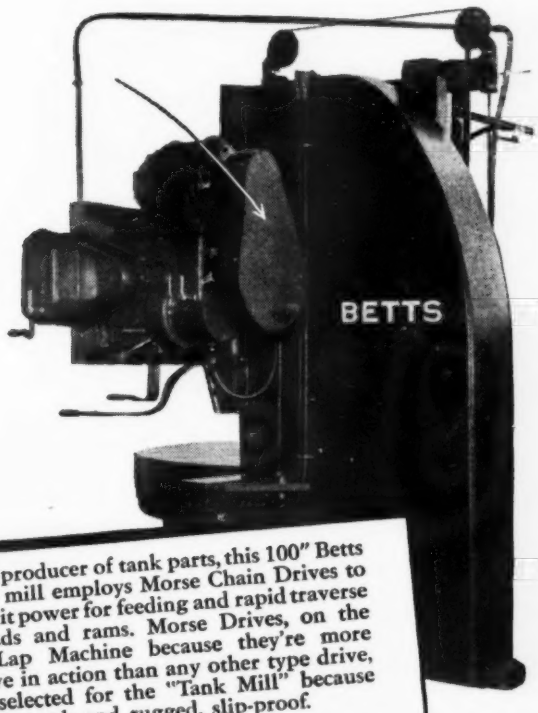
THE LINKS—"metal fingers"—of Morse Chain Drives are tough and sure, slip-proof. That's why Morse Chain Drives are selected for jobs where power must be transmitted with an "iron hand"—firm, steady and dependable—capable of handling even steel mill roll drives of 5,000 h.p. and upward, at high speeds, at practically 100% efficiency—without power losses due to slippage that might occur with other type drives.

BY CONTRAST . . .

Morse Chain Drives, because they operate on the principle of "Teeth Not Tension" and perform like an "iron hand in a velvet glove", are selected for precision work requiring amazingly close tolerances—because they deliver a flow of power that is constant and uniform, assuring a uniformity of produced parts that cannot be approached where driving devices slip or falter even slightly.

* * *

If you are engaged in post-war planning, looking ahead—then look to Morse for equipment that will help your machines to better, speedier production, and lowered production costs. Right now, your nearby Morse representative will be glad to help you solve any power transmission problems relative to essential war-time production.



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CONTENTS

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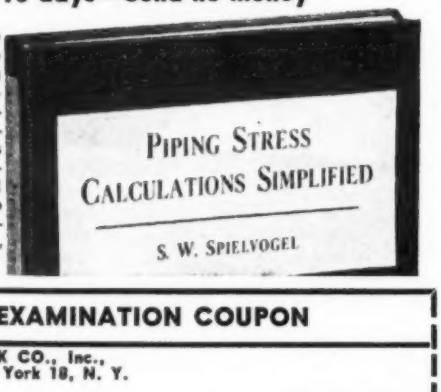

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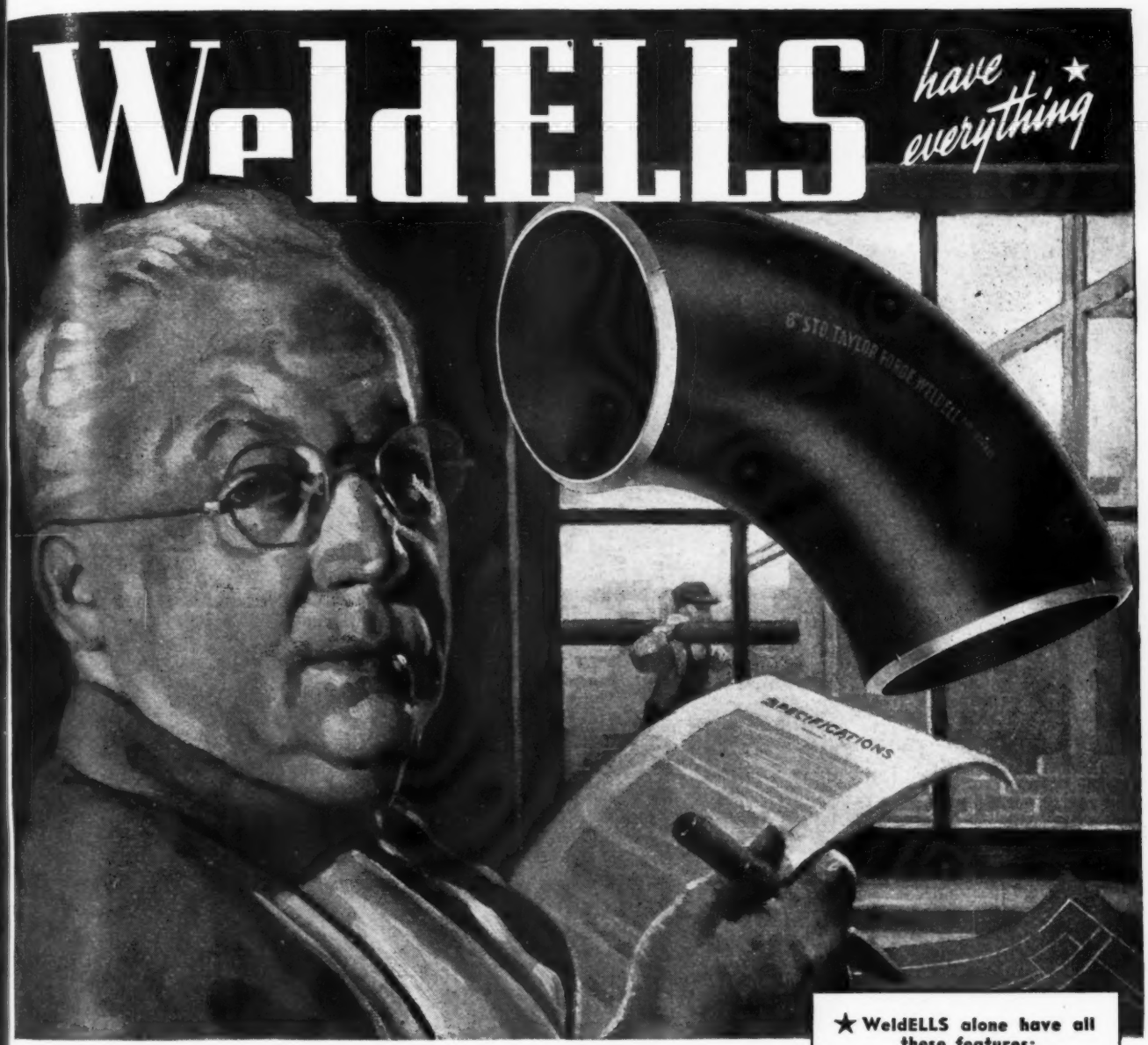

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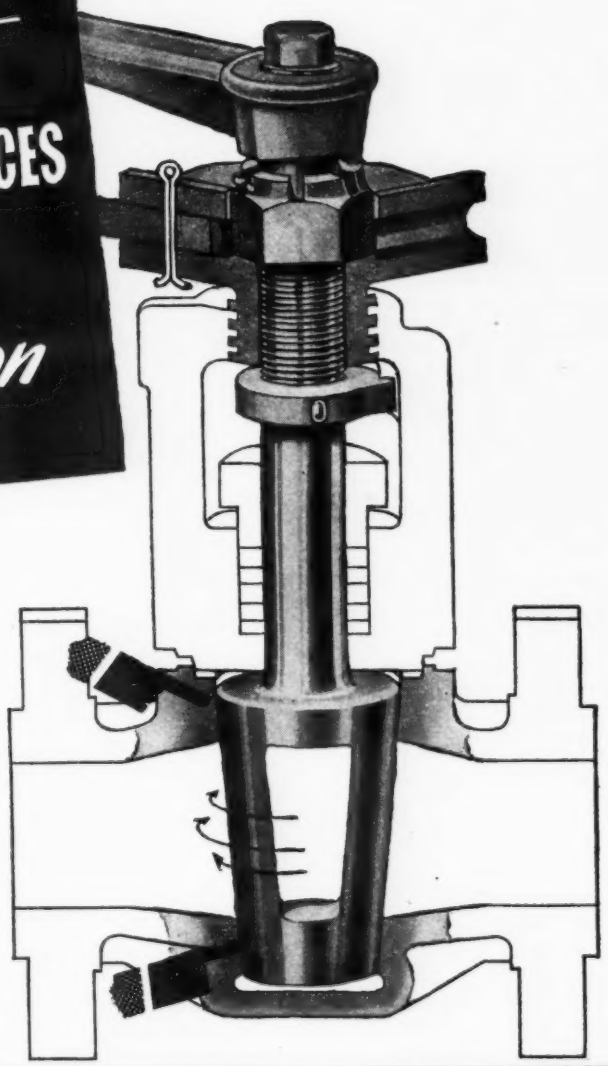

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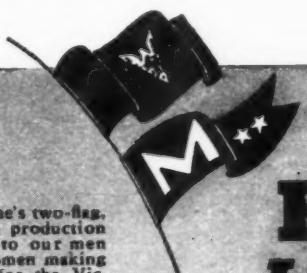

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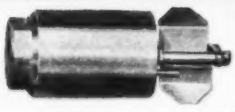

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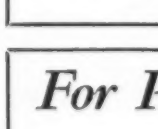

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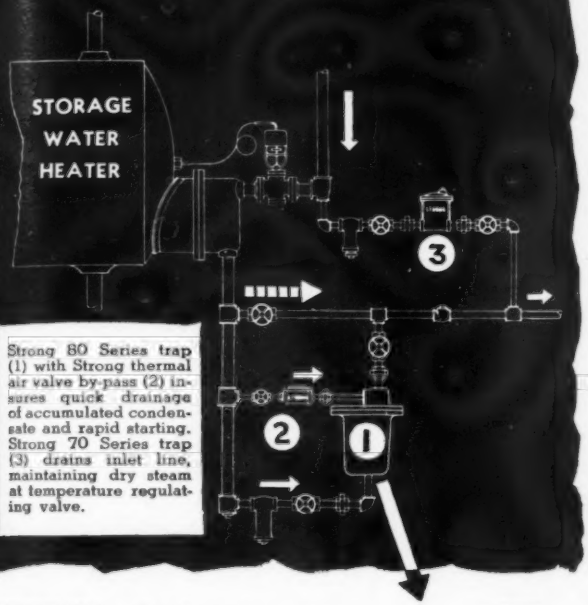

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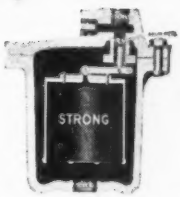

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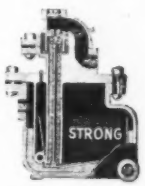

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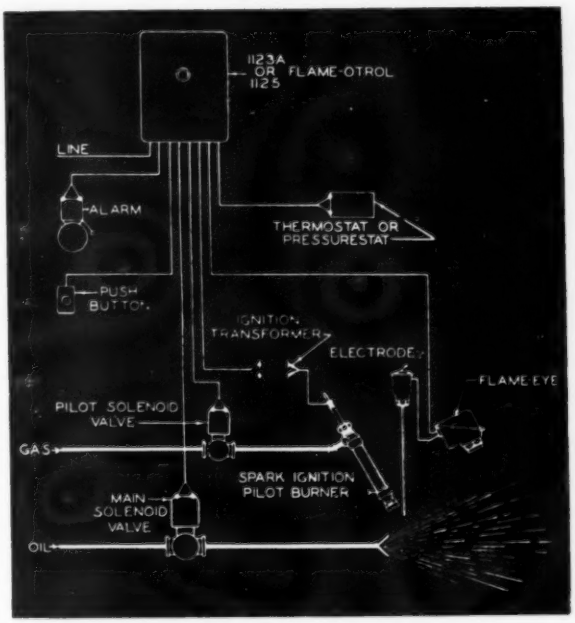

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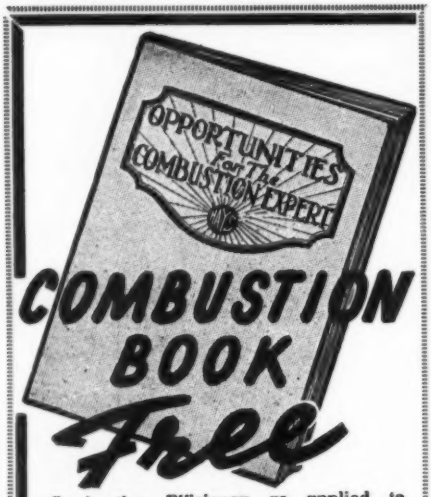

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Of Power, published monthly with an additional Directory number in December, at Albany, N. Y., for October 1, 1943.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. A. Gerardi, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Power, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. 18, Editor, Philip W. Swain, 330 West 42nd St., N. Y. C. 18, Managing Editor, None. Business Manager, E. J. Tangerman, 330 West 42nd St., N. Y. C. 18.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder, the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. Stockholders holding 1% or more of stock: James H. McGraw, 330 West 42nd St., N. Y. C. James H. McGraw, Jr., 330 West 42nd St., N. Y. C. James H. McGraw, James H. McGraw, Jr., and Curtis W. McGraw, Trustees for: Harold W. McGraw, James H. McGraw, Jr., Donald C. McGraw, Curtis W. McGraw, 330 West 42nd St., N. Y. C. Edwin S. Wilsey and Curtis W. McGraw, Madison, New Jersey, Trustees for James H. McGraw, 3rd., Curtis W. McGraw, 330 West 42nd St., N. Y. C. Donald C. McGraw, 330 West 42nd St., N. Y. C. Anna Hugus Britton, 330 West 42nd St., N. Y. C. Mildred W. McGraw, Madison, New Jersey, Grace W. Mehren, 19 No. Country Club Drive, Phoenix, Arizona, Wilson C. Laucks, 1501 Cleveland Avenue, Wyomissing, Pennsylvania.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is. (This information is required from daily publications only.)

J. A. GERARDI, Secretary.

McGRAW-HILL PUBLISHING COMPANY, INC.
Sworn to and subscribed before me this 29th day of September, 1943.

[SEAL] EMILY Z. SHEPARD.

Notary Public, New York County, New York Clerk's No. 768, N. Y. Co. Reg. No. 481275.

(My commission expires March 30, 1944)

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3 phase 60 cycle

3000 KW (2) WESTINGHOUSE 225-285 volts D. C., 225 RPM, with 13200 volt transformers

1700 KW (2) GENERAL ELECTRIC 250 volts D.C., 514 RPM

1500 KW WESTINGHOUSE 225-285 volts D. C. 450 RPM, with 2300/4000-6900/12000 volt transformers

1150 KW GENERAL ELECTRIC 250 volts D.C., 720 RPM

750 KW GENERAL ELECTRIC 600 volts D. C., 1200 RPM, with 2300/4000 volt transformers

ROTARY CONVERTER

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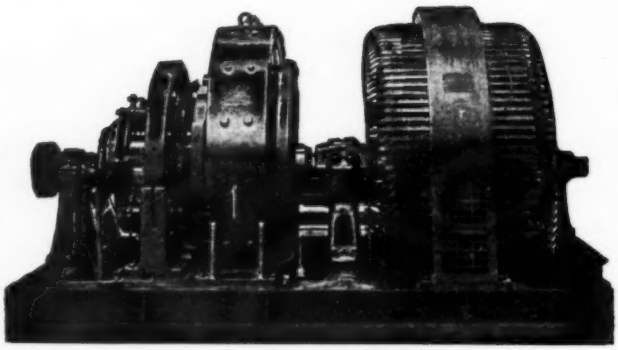
3000 KW WESTINGHOUSE 270 volts D. C., 300 RPM with 9000 volt transformer



Actual Photograph

1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1800 KW (1250 KW 2 hrs. 55 deg. C rises) GENERAL ELECTRIC direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1400 HP 80% P.F. (1750 HP 2 hours 55 deg. C rise) GENERAL ELECTRIC synchronous motor 3 phase 60 cycle 13200/6600 volts 720 RPM. Equipped with D.C. breakers.

MOTOR GENERATOR SETS

3 phase 60 cycle

1000 KW GENERAL ELECTRIC synchronous 125/250 volts 3 wire D. C., 13200/6900 volts A. C., 720 RPM

1000 KW GENERAL ELECTRIC 3-UNIT synchronous 125/250 volts D. C., 4000/2300 volts A. C., 720 RPM

500 KW GENERAL ELECTRIC synchronous 700 volts D. C. 4150 volts A.C. 720 RPM

MOTORS

3 phase 60 cycle

2500 HP GENERAL ELECTRIC synchronous type TS 240 RPM, 11000 volts

625 HP GENERAL ELECTRIC synchronous type TS 180 RPM, 2200 volts

350 HP FAIRBANKS MORSE slip ring type HV 600 RPM, 2200 volts

300 HP WESTINGHOUSE slip ring type CW 490 RPM, 2200 volts

Steam Turbo Generators

3 phase 60 cycle

7500 KVA GENERAL ELECTRIC noncondensing, 425 lbs. 750° TT, 200-250 lbs. back pressure, 13800 volts

3750 KVA GENERAL ELECTRIC 200 lbs. 2300/4000Y volts with surface condenser.

3125 KVA GENERAL ELECTRIC 225/400 lbs. 2400/4160 volts. with surface condenser

2500 KVA WESTINGHOUSE 200 lbs., 600 volts with jet condenser

1875 KVA GENERAL ELECTRIC 150 lbs. 2300 volts with surface condenser

1250 KVA ALLIS CHALMERS 150/200 lbs. 2300 volts with jet condenser

500 KVA WESTINGHOUSE noncondensing, 150 lbs. 5 lbs. back pressure, 480 volts

SURFACE CONDENSER

1540 sq.ft. WORTHINGTON surface condenser with steam jet air pumps

Steam Engine Generators

3 phase 60 cycle

500 KVA GENERAL ELECTRIC Ames uniflow, 175 lbs., 5 lbs. back pressure, 240 volts

500 KVA ALLIS CHALMERS Corliss, 175 lbs. 25 lbs. back pressure, 240/480 volts

438 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts

300 KVA GENERAL ELECTRIC-AMES twin uniflow, 175 lbs. 10 lbs. back pressure 240/480 volts

210 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure 240/480/2300 volts

STEAM ENGINE GENERATORS

250 Volts D.C.

500 KW CROCKER WHEELER AMES, 4 cylinder vertical uniflow, 150 lbs., 5 lbs. back pressure

250 KW CROCKER WHEELER-SKINNER uniflow, 115 lbs. 3 lbs. back pressure

Diesel Engine Generators

3 phase 60 cycle

333 KVA GENERAL ELECTRIC DE LAVERGNE 4 cylinder 2300 volts, 225 RPM

230 KVA GENERAL ELECTRIC WORTHINGTON 4-cylinder, 440 volts, 327 RPM

225 KVA WESTINGHOUSE-WORTHINGTON 3-cylinder, 2300 volts, 275 RPM

200 KVA FAIRBANKS-MORSE 4 cylinder 2400 volts, 257 RPM

187 KVA GENERAL ELECTRIC McINTOSH - SEYMOUR 4-cylinder, 2300 volts, 257 RPM

170 KVA FAIRBANKS-MORSE 4 cylinder 2400 volts, 257 RPM

156 KVA ELECTRIC MACHINERY-COOPER BESSEMER 3-CYLINDER, 240 volts 300 RPM

125 KVA WESTERN ELECTRIC WORTHINGTON 2-cylinder, 2300 volts, 277 RPM

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MOTORS GENERATOR SETS

1—2000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—70 KW, 125 volt, Crocker-Wheeler synchronous
1—20 KW, 600 volt, General Electric squirrel cage induction motor.
1—6½ KW, 125 volt, General Electric, squirrel cage

ALTERNATORS

1—526 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 900 RPM., 440 volt, Al. Ch. sl. rg.
1—150 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—150 HP, 600 RPM, 440 volt, G.E. sl. rg.
1—150 HP, 400 RPM, 440 volt, G.E., sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 900 RPM, 440 West. sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT
25—Westinghouse type U Recording Volt-meters.

MOTORS—3 PHASE 60 CYCLE (Con't)

2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SM.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type L.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—25 HP, G.E., 650 RPM, Type RC-15.
1—20 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
2—20 HP, Westghse., 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—250 KVA, G.E., 6600/2200/220/440.
3—200 KVA, G.E., 2200/220/440.
3—150 KVA, G.E., 33,000/ 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, G.E., 2200/220/110.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
3—37½ KVA, G.E., 2200/220/440.
7—25 KVA, Westg., air cooled, 440/220-110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

1—150 HP, 350/1050 RPM, Crocker-Wheeler.
2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-1101.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.

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3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
1—200 KVA, G.E., type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—150 KVA Pittsburgh, 2300/115/230 volts, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
OTHER SIZES, VOLTAGES AND CYCLES

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW Westh. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.
50 KW Milwaukee, Comp. Wound 125 V, 600 RPM.

MOTOR GENERATOR SET

Western Elect. 1000 Amps—40 Volts direct con. to either an AC or DC 580 RPM Motor.
125 K.W. Crocker Wheeler, 250 Volts D.C. Comp. WD. Dir. Con. To G.E. 2300 or 440 Volts Sq. Cage Motor

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
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25 H.P.—Form E—550 Volts—760 RPM

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle, 750 speed, 220/230 volts. With Transformers for 2300 volts.

FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ½ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543—3 ph. 25 cy. 220 volt 750 RPM.

OTHERS IN ALL SIZES VOLTAGES AND CYCLES

3 ph. 60 cy. A. C. MOTORS

H.P.	Make	Type		Speed	Volts
200	West	Syn.	.08 P. F.	900	220/440
		WITH DIRECT CON. EXCITER			
200	Wsghse.	Sl. Rg.	CW	600	220/440
200	Gen. Elec.	Sq. Cg.	1 Form K	514	220/440
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I K	600	2300
150	Al Ch.	Sq. Cg.		600	440
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	SR	MT. 553	1200	220
125	Gen. Elec.	Sq. Cg.	I K	720	220/440
125	Gen. Elec.	Sq. Cg.	KT547	1800	440

3 ph. 25 cy. MOTORS

H.P.	Make	Type		Speed	Volts
830	Elect. Mach.	Syn.		500	2300
		With Direct Connected Exciter			
200	Lincoln	S.R.	I.X.W.	500	440
150	Burke	Syn.		500	440
		With Direct Connected Exciter			
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/440
100	Gen. Elec.	Sq. C.	I K	750	220/440
100	Wsghse.	Sq. C.	CS	500	220/440
75	Wsghse.	Sq. C.	CCL	500	220/440
75	Gen. Elec.	Sl. Rg.	I M	750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440
50	Burke	Syn.	AC133	750	220
		WITH DIRECT CON. EXCITER			

230V D. C. MOTORS

H.P.	Make	Type	Speed
125	G.E.	CL	850
100	Northwestern	K30 Comp. Inter.	1750
100	Wsghse.	SK143 Shunt Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
67	Otis	Elevator Motor-Comp. wd.	1200
60	Sprague	D—Comp. Wound	625
50	Gen. Elec.	C. L. 6 Shunt Wound	560
50	West.	SK120	1700
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	190

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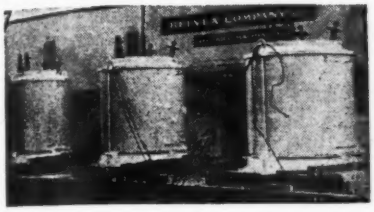


MOTOR GENERATOR SETS

3 Phase 60 Cycle

1—600 KW 3 unit consisting of 2—250 KW G.E., 250 V., d.c., to 1—700 HP, 2300 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 2200 V.

1—500 KW G.E., 250 V. D.C. to 1000 KVA. 2300 V. Syn. Motor.

1—400 KW G.E., 250/275 V., D.C. to 600 HP, 2300 V.

1—100 KW WHSE., 250 V. D.C. to 150 KVA. 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg., 1200/4000 V.

1—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 220 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

1—15 KW Cont. 230 volt D.C. to 25 H.P. 220 volt sq. cg. motor.

1—10 KW Balancing Set Gen. Elec. with 2—5 KW —125 volt generators.

TURBO GENERATOR SETS

1—600 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D. C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

A. C. GENERATORS AND SYNO. MOTORS

3 Phase—60 Cycle

HP or KVA	Make	Type	Volts	Speed
1—1000	Whse.		2300	900
1— 625	Whse.		480	900
1— 500	G.E.	TS	440	360
1— 250	G.E.	ATB	2300	600
1— 250	G.E.	AT1	220	450
1— 225	G.E.	ATB	220	600
1— 150	Whse.		2400	900
1— 150	Whse.		4000	1800
1— 100	Whse.		2400	900
1—3100	Whse.		2300	1800

A. C. MOTORS

3 Phase—60 Cycle
SLIP RING

HP	Make	Type	Volts	Speed
2—1200	Cr. Wh.	801Q	2300	327
1— 800	Al. Ch.	ANY	440	885
1— 800	Whse.	CW	440	327
1— 600	G.E.	IM	440	900
1— 450	Whse.	HW	2300	575
1— 400	Al. Ch.	ANY	440	1200
1— 400	G.E.	MT	550/440	300
1— 400	Al. Ch.	ANY	2300	505
1— 350	G.E.	MT-442	2300/4000	257
1— 300	G.E.	IM	440	720
1— 300	Whse.	CW	440	585
1— 250	G.E.	MT	4000/2300	257
2— 200	G.E.	IE-M	2300	1750
1— 200	Whse.	CW	2300	514
1— 200	G.E.	I-M	440	600
1— 150	G.E.	IM	2300	695
1— 150	G.E.	MT-564	440	600
1— 150	G.E.	IM-17B	2300	390
1— 100	G.E.	IM	220	1750

A. C. MOTORS

SQUIRREL CAGE

H.P.	Make	Type	Volts	Speed
1—500	G.E.	I-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—200	Whse.	CS	2300	1200
1—200	G.E.	IK	2300	490
4— 175	G.E.	IK	440	900
1— 150	Lincoln		440	1200
1— 150	G.E.	IE	440	1200
1—150	Al. Ch.	AN	440	1765
1—100	Whse.	CS	550	1750

GEAR REDUCTION UNITS

1—2100 H.P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5506/1200 RPM.
1— 750 H.P. Al. Ch. 3600/600 RPM.
1— 450 H.P. G.E. 3600/1200 RPM.

THE BELYEA REPUTATION PROTECTS YOU!

ROTARY CONVERTERS

3 Phase—60 Cycle

1—1500 KW Whse., 720 RPM., D.C. 600 V. A.C. 11500 V.
1—1500 KW Whse., 600 RPM., D.C. 600 V. A.C. 11500.
1—1250 KW G.E., HCC, 720 RPM., D.C. 250 V. A.C. 2300 V.
1—1000 KW Whse., 900 RPM., D.C. 600 V. A.C. 11000/2300 V.
2—750 KW Whse., 1200 RPM., D.C. 600 V. A.C. 5500/2300 V.
1—750 KW Whse., 900 RPM., D.C. 600 V. A.C. 6600/2200 V.
1—500 KW Whse., 900 RPM., D.C. 250 V. A.C. 2300 V
1—500 KW Whse., 1200 RPM., D.C. 600 V. A.C. 2300 V.
2—375 KW Whse., 1200 RPM., D.C. 250 V. A.C. 2300 V.

Rotary Converters

3 Phase 25 Cycles—Booster Type

2—1500 KW G.E., HCC, 500 RPM., D.C. 225/275 V., 6000 Amp., A.C. 13200/6600 V.
1—600 KW G.E., HCC, 750 RPM., D.C. 225/275 V., 2000 Amp., A.C. 6600 V.

TRANSFORMERS

60 Cycle

KVA	Make	Ph.	Type	Voltages
6—1667	Pitts	1	OISC	13200x2300
4— 525	G.E.	1	HJ-DD	2300x445
2— 400	Whse.	1	S	2400x440
2— 333	Whse.	1	OISC	2300x460
2— 333	Pitts.	1	OISC	2400x220
3— 300	G.E.	1	H	13200x2300/575
2— 200	G.E.	1	HILD	26400x115/460
2— 200	G.E.	1	H-KDD	13800x220/440
3— 150	Whse.	1	SK	2200x440/220
3— 150	Whse.	1	SKM	2400x120/240
6— 100	Whse.	1	SK	6900x460/230
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1250	G.E.	MCF	250	550
2—1250	G.E.	MPC	600	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
2— 600	G.E.	MPC	550	600/800
1— 350	G.E.	MPC	230	450
1— 300	G.E.	MCF	230	400/100
3— 300	G.E.	DMC	230	400/600
1— 300	Cr. Wh.	CMC 102H	230	1150
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
1— 250	Al. Ch.	Irt	230	525
2— 200	Whse.		230	400/500
1— 175	Whse.	SK	250	150/525
2— 150	G.E.	RC-19	230	800/1000
1— 150	Cr. Wh.	CCM	230	300/1050
1— 150	Whse.	SK	230	300/900
2— 125	G.E.	CO-1832	230	625
2— 120	Whse.	SK	230	720
1— 100	Al. Ch.		230	950/1150
2— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
3— 100	G.E.	RC-19	230	575/720
1— 75	G.E.	C	230	500/100
3— 70	Whse.	SK-183	230	560/780
4— 60	Diehl	K-11	230	500/1000
2— 60	Cr. Wh.	CMC-65H	230	500/1000
1— 50	Cr. Wh.	CMC-51H	230	300/900
1— 50	Cr. Wh.	CMC-50H	230	380/750
1— 50	G.E.	BC	230	400/1200

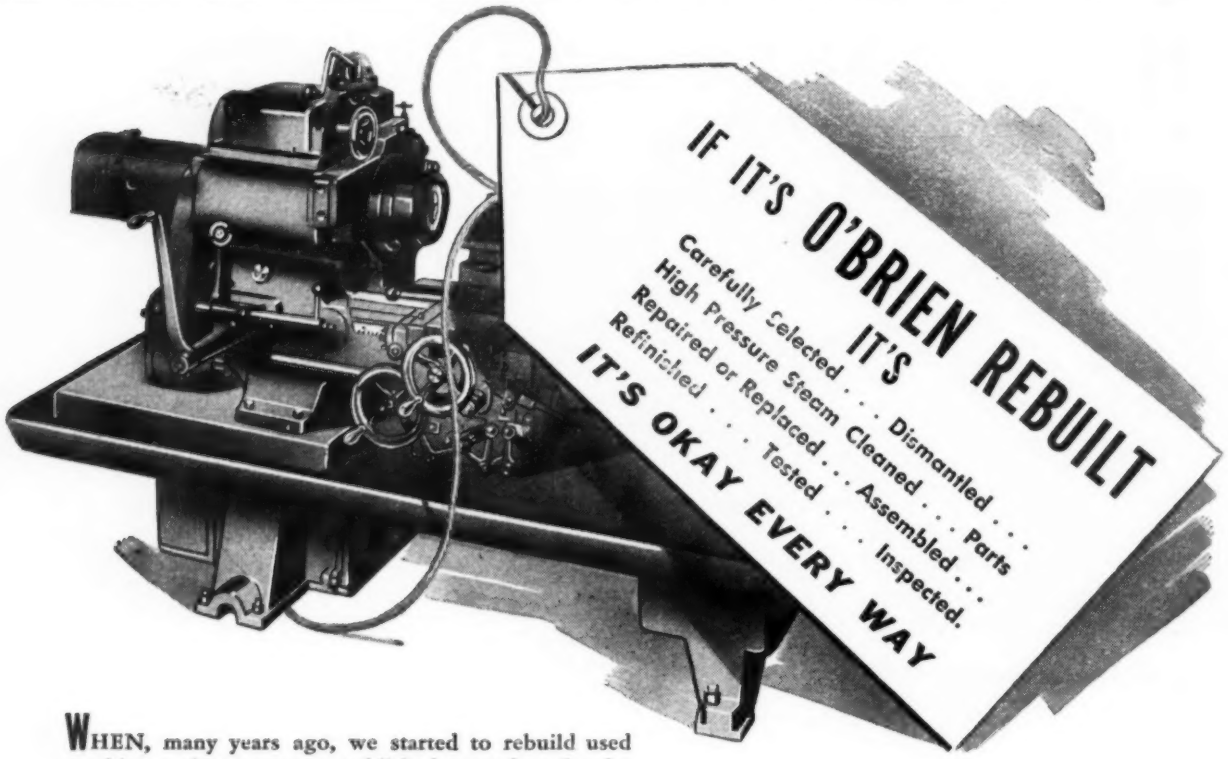
RE-NUBILT BELYEA MOTORS

SUCCESSFUL OPERATION GUARANTEED

BELYEA

COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.


IF IT'S O'BRIEN REBUILT
IT'S
Carefully Selected . . . Dismantled . . . .
High Pressure Steam Cleaned . . . Parts
Repaired or Replaced . . . Assembled . . .
Refinished . . . Tested . . . Inspected.
IT'S OKAY EVERY WAY

WHEN, many years ago, we started to rebuild used machinery, there was no established procedure for doing a job. How to do it, how much to do or how well to do it hadn't been standardized. So, for your protection and for our own future, we carved out our own formula. O'Brien rebuilding of power plant equipment and machine tools now means complete rebuilding, often good-as-new performance and often, by incorporating improvements, better than original performance. That's why our customers stay on our books for years.

CENTRIFUGAL PUMPS — MOTOR DRIVEN

GPM	Make	Size	Head
5000	Worthington	12"	120'
4600	Byron Jackson	12"	96'
3500	Worthington	12"	22'
2800	Cameron	10"	81'
2500	Frederick	10"	100'
1800	Worthington	8"	360'
1000	Deming	5"	47'
900	Ingersoll-Rand	6"	62'
800	Deming	5"	66'
710	Byron-Jackson	4"	350'
675	Lea-Courtney	4"	1100'
600	Lea-Courtney	3"	650"
600	Deming	5"	40'
500	Morris	4"	350'
450	Allis-Chalmers	2½"	325'
300	Goulds	3"	150'
300	DeLaval	3"	60'
250	DeLaval	3"	60'
250	Lea-Courtney	3"	525"
150	Ingersoll-Rand	2"	530'
100	Ingersoll-Rand	1½"	530'

ALL UNITS MOTOR DRIVEN WITH SUITABLE VOLTAGES

STEAM ENGINE GENERATOR SETS
Alternating Current

1000 KVA West.—Skinner Uniflow 3/60/440
750 KVA G.E.—Skinner Uniflow 3/60/2300
625 KVA West.—Skinner Uniflow 3/60/440
500 K.V.A. G.E.—Ames Uniflow 3/60/240.
400 KVA Allis-Chalmers Corliss 3/60/480
375 KVA West.—Skinner Uniflow 3/60/440
325 KVA G.E.—Chuse Uniflow 3/60/220/2300
300 KVA G.E.—Ames Uniflow 3/60/480

STEAM TURBINE GENERATOR SETS
Condensing—A.C.

1—4000 KVA Allis Chalmers 3/60/2300/3600 RPM
1—3125 KVA Gen. Elec. 3/60/2300/3600 RPM
1—1560 K.V.A. Westinghouse Bleeder 3/60/480.
1—1500 KVA Westinghouse 3/60/2300/3600 RPM
1—1250 KVA Gen. Elec. 2/60/2300/3600 RPM
1—750 K.W. Allis Chalmers 3/60/480/3600.
1—625 K.W. Allis Chalmers 3/60/480/3600..
3—625 KVA Allis-Chalmers 3/60/2300/3600 RPM
1—625 KVA Gen. Elec. 2/60/2300/3600 RPM
1—500 KVA West. Geared, 3/60/2400/6000—900 RPM
3—500 KVA Gen. Elect. Bleeder 3/60/220/3600 RPM
1—250 KVA Worthington Moore Bleeder 3/60/220
1—187 KVA Westinghouse geared 3/60/2300
1—150 KVA Westinghouse 3/60/240/3600 RPM

Non-Condensing—A.C.

1—500 KVA West.-Moore 3/60/220 New 1931.
1—500 KVA G.E.—Terry 3/60/120/208/3600 RPM New
1—500 KVA Westinghouse geared 3/60/480 New
1—375 KVA Westinghouse geared 3/60/2300
1—375 KVA Allis Chalmers 3/60/240/3600 RPM
1—125 KVA Al. Ch.—Kerr 2/60/220/3600 RPM
1—75 KVA Allis-Chalmers 3/60/240/3600 RPM

A. S. M. E. BOILERS

2—686 H.P. Sectional Header 3 Drum Straight tube 200 lb. Non Code.
1—500 H.P. Keeler-Wetzel Stoker, 160 lbs.
1—400 H.P. Wickes 200 lb. New 1931 with Stoker.
1—400 H.P. Babcock Wilcox W.T. 200 lb. W.P.
2—300 H.P. Edgemoor 160 lb. Taylor Stokers New 1931
2—250 H.P. International self-contained, 200 lbs.
1—200 H.P. Coatesville H.R.T. 150 lbs.
2—100 H. P. Erie H.R.T. 160 lb. with Stokers.

Everything from a Pulley to a Power House

THE O'BRIEN MACHINERY CO.

PHILADELPHIA'S LARGEST MACHINERY DEALERS AND EXPORTERS

113 NORTH THIRD STREET • PHILADELPHIA 6, PENNA.

BELL TELEPHONE: MARKET 4180 CABLE ADDRESS: OBRIEN PHILA

Now Is the Time to Throw Everything We Have at the Enemy and Save Hundreds of Thousands of American Boys

TURBOS—60 cycles

15000 KW capacity condensing, non-automatic bleeder (approved 275# 550° t.t.) volume extraction at either 100 or 65 = g.b.p. Elspecs 60/3/standard voltage. Complete going unit including surface condenser, all auxiliaries and piping.

•

3—5000 KW 80% nominal, 7200 KVA range, 225# I.S.P. Elspecs 60/3/2300/3600. High percentage original full strength, otherwise necessary blading in stock.

2—3125 KVA Multi-Stage Condensing 60/3/2300/3600. One complete with surface condenser lay out and all standard auxiliaries for complete installation; One now with jet condenser, but liberal capacity surface condenser available from other stores.

3—2000 KW 80% nominal, 2500 KW approved range 60 3 1-440, 2-2300, condensing design and approved for non-condensing.

•

Several 300, 500, 750, 1000, 1200 and 1500 KW condensing standard pressure, also mixed pressure design.

•

TURBOS—25 cycles

50,000 KW total aggregate capacity, unit sizes of 3,000, 6,000 to 20,000 KW surface condenser equipped complete going units. High percentage full strength.

SURFACE CONDENSERS

8250, 11000, 12000, 15000 and 20000 sq. ft. surface condenser units complete. Log service on pure clear water. Condition sound.

WATER TUBE BOILERS

2—350# ASME 80,000/120,000# t.s.g. cross drum units, underfeed stoker equipped.

WATER TUBE BOILERS (Con't)

4—1000 HP Steel Header Longitudinal Drum Type Water Tube Boilers 250# ASME Code design, and verified in recent inspection for re-erection. Now oil fired.
A complete going boiler station including modernly designed self-supported steel structure, and all standard boiler plant auxiliaries, piping, etc.
Approximately 2½ to 3 years each total log hours service.

•

3—700 HP 160,000# t.s.g. straight tube box steel header 200# ASME, without firing equipment.

•

8—400 HP 200# ASME bent tube design, superheaters, soot blowers, fans, heaters, coal and ash handling paraphernalia, etc. Also complete steel building.

•

8—650 HP Babcock Wilcox sectional header straight tube 2 longitudinal drum type 200# approved water tube boilers, superheater and type E heavy duty stoker equipped.

•

12—200/500 HP straight and bent tube 200# units.

STOKERS

5 type E heavy duty combustion engineering company stokers.

•

30 combustion engineering company multiple retort stokers.

LARGE POWER TRANSFORMERS

50,000 KVA O.I.W.C. transformers 150,000/135,000 delta—41,600/36,400; or 72,000/63,000 star.

9000 KVA transformers, as above.

15,000 KVA O.I.W.C. 60,000/54,000—18,000/9000.

12,000 KVA O.I.W.C. transformers, 18,000 through 12,000, 500 and 250 KVA unit sizes, 75,000/43,000—2300 and other standard voltage ratios.

Complete data available on request.

"LOYAL COOPERATION IN HEAVY POWER MOVEMENT THRU 3 WARS"

"Now in World War II—May We Confirm Intent and Ability, Face to Face?" . . . P.S.

"ELECTRIC EQUIPMENT" STOCK-LIST

MOTORS

DIRECT CURRENT MOTORS

CONSTANT SPEED—230 volt

HP	Make	Type	RPM
300	G.E.	DMC INT	800
100	G.E.	CD 123	1200
75 KW.	Cr Wh.	81 H Gen.	725
75	Cr. Wh.	516761	1050
60	G.E.	RC 34	1050
60	West.	SK 123L	1800
50	Cr. Wh.	CMC-H50	750
50	Al-Ch.	E 123	1200
40	G.E.	RC 15	700
40	West.	SK	775
40	G.E.	RC	1050
40 KW.	West.gen.	SK	1800
35 KW.	G.E.gen.	DLC	900
30	West.	SK 133	600

Also 130 other DC motors—40 HP. and smaller any speed.

VARIABLE SPEED—230 volt

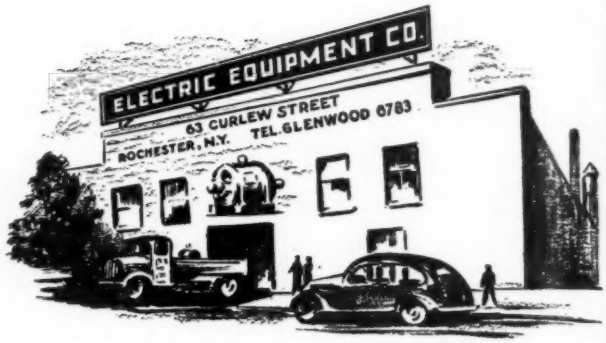
175	G.E.	DLC 206	650/ 925
80	Burke	CD 60	200/ 625
60	Sprg.	Intpl.	480/1100
50	G.E.	RLC	400/1200
35	West.	SK	500/1500
35	G.E.	RLC	500/1500
25	West.	SK 150	400/1200
25	G.E.	RF 14	400/1200
20	El. Dy.	208	400/1200
15	E. Dy.	208	410/1200
20	West.	SK	400/1200
30	G.E.	RLC 203A	300/ 900
15	West.	80 L	1150/1800
15	G.E.	RF 13	300/ 900
15	West.	SK 93	600/1800

45 motors, 230 volt DC variable, all speed, 15 HP. or smaller.

AC GENERATORS 60 CYCLE

HP	KVA	Make	Type	Volts	RPM
300	KVA	G.E.	ATB-PB	480	720
250	HP.	West.	4846672	240	1800
240	HP.	G.E.	ATI	200	514
225	KVA.	G.E.	ATB	200	720
200	KW.	G.E.	ATB-PB.	550	720
200	HP.	G.E.	ATI syn.	2300	900
150	KW.	West.	640451	2200	600
150	KW.	G.E.	ATI	2300	900
150	KW.	G.E.	ATB-PB	600	900
120	KW.	G.E.	ATB-PB	2300	720
105	HP.	El.Ma.	BRT	2300	1800
100	HP.	G.E.	ATI-PB	2300	900
100	HP.	G.E.	ATI-PB	220	900
75	KW.	G.E.	ARB-PB	2300	900
75	KW.	G.E.	ATB-PB	550	900
60	KVA.	G.E.	ATB-P	2300	900
60	HP.	G.E.	ATI-PB	4000	900
54	KVA.	G.E.	ATB	220	900
50	KW.	G.E.	TRB	240	1200
50	KVA.	West.	Ac gen.	240	1200
37½	KVA	G.E.	ATB-PB	240	1200
25	KW.	G.E.	TAB	240	1800

40 Generators AC. in stock 20 KW. or smaller. Write for details.



MOTOR GENERATOR SETS AC to DC

Kw.	Make	Volts	Speed	Hp.	Cy.	Volts
200	G.E.	125	750/735	300	25	440
100	Cr. Wh.	275	1750	150	60	2200
100	West.	250	600	145	60	440 syn.
75	G.E.	250	1150	115	60	220
70	Burke	70	1200	110	60	220 syn.
50	West.	125	750	75	25	2200
35	G.E.	125	1750	50	60	2300
35	Cr. Wh.	125	1750	50	60	220
25	G.E.	250	1200	35	60	220
10	G.E.	30	1500	20	25	220/440
9	West.	60	1750	15	60	220
8	Al-Ch.	125	1500	13	25	440
5	West.	80	1450	10	25	220

MOTOR GENERATOR SETS AC to DC

Kw.	Make	Volts	Speed	Hp.	Cy.	Volts
5	West.	80	1750	7½	60	220
5	G.E.	250	1750	10	60	550
3	G.E.	32	1800	7½	60	220
2½	G.E.	15	1800	5	60	220

MOTOR GENERATOR SETS DC to AC

Kva.	Make	Volts	Phase	Cy.	Hp.	Volts	Speed
15	West.	250	single	60	25	230	1800
10	G.E.	220	single	25	15	230	750
7½	West.	220	3	60	13	230	1800
4	West.	220	3	60	5	230	1800

60 CYCLE MOTORS

SQUIRREL CAGE

HP	Make	Type	Volts	RPM
200	G.E.	I-K	2200	600
200	West.	CS	2200	1200
150	G.E.	I-K-16	2200	600
150	Al-Ch.	AN	2200	900
150	Al-Ch.	AR	440	900
150	G.E.	I-K	2200	1200
150	West.	CS	440	1800
150	G.E.	I-K 13A	2200	1800
125	Tmph.	TR 14	440	1800
125	G.E.	I-K	4150	450
100	G.E.	I-K	2200	720
100	G.E.	KT 556	2200	900
100	G.E.	I-K	440	900
100	Al-Ch.	AR 226D	440	900
100	G.E.	KT 543	440	1200
100	G.E.	I-K	440	1800
75	G.E.	KT 552	2200	900
75	G.E.	KT 352	440	900
75	Howell	SC	440	1800
75	West.	CS	440	1800
75	Ideal	A 306 B.B.	440	3600
60	G.E.	KT 333	440	1800
50	G.E.	I-K 15A	440	300
50	G.E.	I-K	440	720
50	G.E.	KT 542	550	900
50	G.E.	KT 336	550	1200
50	G.E.	KT	440	1800
50	F-Mac.	HO121C	440	3600
50	G.E.	KT 527	2200	1800
50	F.Mac.	B.B.	2200	3600

200 Motors 30 HP. and smaller all speeds and types in stock.

SLIP RING

HP	Make	Type	Volts	RPM
400	G.E.	I-P	2200	257
300	G.E.	I-M	2200	1200
200	G.E.	I-M 17A	440	514
200	G.E.	I-M 17	550	514
200	G.E.	I-M 17	2200	600
150	G.E.	I-M 16	2200	600
150	G.E.	I-M 16	550	600
150	West.	CW	2300	720
150	Cr-Wh.	Late	440	900
150	G.E.	I-M	2200	900
150	G.E.	I-M 15	440	900
150	West.	CW 771.1c	440	1800
125	G.E.	MT 547	2300	1800
112	G.E.	ITC 5015	550	514
100	G.E.	MT 356	440	900
100	G.E.	I-M	440	900
100	G.E.	I-M	440	1800
75	Al Ch	ANY	440	514
75	G.E.	MT 556	550	720
75	G.E.	MT 356	2200	720
75	G.E.	I-M	220	1800
60	G.E.	MT 556	440	600
60	G.E.	MT 352	440	720
60	G E	MT 346	440	900
50	G.E.	I-M	440	514
50	G.E.	MT 352	2200	720
50	G.E	MT 352	220	720
50	G.E.	MT 346	2200	900
50	G.E.	I-M	440	1200
50	G.E.	MT 536	440	1200
50	West.	CW	440	1800
50	G.E.	I-M	440	1800

50 Smaller slip ring motors 15 HP. and smaller any speed.

25 CYCLE MOTORS

Alternators—Synchronous 3 phase, 25 cycle

HP	KVA	Make	Type	Volts	RPM
600	KVA	G.E.	ATI	550	500
300	HP	Elec.	Mach.	440	214
100	HP	Elec.	Mach.	440	600
75	HP	Elec.	Mach.	2200	500
20	KW	Ideal		240	1500

SQUIRREL CAGE 220-440 volt 3 phase

HP	Make	Type	Volts	RPM
300	G.E.	I-K	440	1500
150	G.E.	I-K	440	750
150	West.	CS	440	1500
125	G.E.	KT 561	440	750
100	West.	CCL	440	500
100	G.E.	I-K	440	750
75	G.E.	I-K	440	750
75	G.E.	I-K	440	500
60	Lincl.	IN	220	1500
50	G.E.	I-K	440	750
50	G.E.	KT 353	440	750
50	F-Morse	H-16B	440	750
50	West.	CS	440	750
40	West.	CS	440	750
40	G.E.	KT 343	440	750
40	Al.-Ch.	AN	440	1500
40	G.E.	KT 337	440	1500
35	G.E.	I-K	440	750
35	West.	CS	440	750
35	G.E.	I-K	440	1500
30	Wagn.	22 VBP	220	750
30	G.E.	KT	440	750
30	G.E.	KT 343	440	750
30	West.	CS Tot.En.	440	750

Also 150 motors from 20 HP. to 1 HP. all speeds.

SQUIRREL CAGE 2200 volt AC 25 cycle, 3 phase

HP	Make	Type	Volts	RPM
100	G.E.	I-K	2200	1500
100	G.E.	KT 553	2200	1500
100	West.	CCL	2200	500
75	West.	CS	2200	750
50	West.	CS	2200	750
50	Al-Ch.	AR 226M	2200	1500
50	G.E.	I-K	2200	1500
40	West.	CS	2200	750
35	G.E.	I-K	2200	500
30	G.E.	KT 337	2200	750
30	West.	CS 753	2200	750

SLIP RING 3 Phase, 25 cycle

125	Al-Ch.	AN	440	750
125	G.E.	I-M	440	1500
100	G.E.	I-M	2300	375
100	G.E.	MT 357	440	1500
75	G.E.	I-M	2200	750
75	G.E.	I-M	2200	500
75	West.	CI 756A	440	500
60	West.	CW 765A	440	750
50	Al-Ch.	ANY	220	500
50	G.E.	I-M	440	750
50	West.	CW	440	750
40	West.	CW	440	750
37	G.E.	ITC 5015	220	1500
30	Al-Ch.	ARY	440	750
25	G.E.	MT 337	220	750

25 other motors smaller than 25 HP in stock.

New-Rebuilt

ELECTRIC EQUIPMENT CO.

63 CURLEW ST. PHONE: Glenwood 6783 ROCHESTER 1, N. Y.

MOTORS • GENERATOR SETS • TRANSFORMERS • CAPACITORS • AIR-OIL CIRCUIT BREAKERS • COMPENSATORS • ALTERNATORS • GAS ENGINES • PANEL BOARDS

REBUILT POWER EQUIPMENT

READY TO SHIP!

ROTARY CONVERTERS

1—200 kw. G.E. 275 v. 900 rpm., 6 ph. 60 cy. complete with overspeed device and transformers.

1—500 kw. G.E. type HC-8 600 volt, 900 rpm., 6 ph., 60 cy. pedestal bearing with overspeed device complete with transformers.

MOTOR GENERATOR SETS

150 KW Ridgway 250 v. DC, 900 rpm. dir. con. 2300/3/60 syn. motor, complete.

1—150 kw. Crocker Wheeler 250 v. DC, 600 rpm. dir. con. to 220/440 or 2200 v. syn. motor.

125 kw. Cr. Wh. 250 v. D.C. 1200 rpm., 220/440 v. 3 ph. 60 cy. Ind.

ENGINE GENERATOR SETS

225 kw. Elec. Machy 2200 or 220 v. 3 ph. 60 cy. dir. con. Ideal Steam.

1—225 kw. Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 200 rpm. dir. con. Ideal Engine 4 valve non-releasing.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)

1—150 kva. Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.

1—250 KW 480 V., 3/60, Allis-Chalmers, 150 rpm.

A.C. MOTORS—3 ph. 60 cy.

Qu	HP	Make	Volts	Speed	Type
18	½	G. E.	220	900	K
33	½	G. E.	220	1140	K
19	1½	Ilg.	220	490	ball bearing
1	40	G. E.	220/440/550	1200	I-8
1	40	West.	440	900	C
1	40	W. El.	440	720	CS
2	40	West.	220	600	——
2	40	West.	220	514	CS
1	40	Am. El.	440	685	——
		(Vertical-ball bearing)			
2	40	Am. El.	440	685	PK
		(Enlosed-ball bearing)			
1	40	West.	220	600	CS
2	40	West.	440	1800	MS
1	40	G. E.	220/440	1160	K
1	40	Triumph	440	860	13–12
1	40	G. E.	440	860	KT
1	50	Chandeys.	220/440	1800	——
1	50	Al. Ch.	220	1200	——
1	50	G. E.	440	1200	KT
1	50	Triumph	440	1200	B-12
1	50	G. E.	440 only	1200	I
2	50	A. E. C.	440	900	PK-enclosed
1	50	A. E. C.	440	900	vertical
3	50	West.	220	720	——
1	50	West.	220	514	CS
1	50	Reliance	440	1200	——
7	50	Al. Ch.	440	1800	AN
2	50	West.	440	1800	C
1	50	West.	440	1120	C
1	50	G. E.	440	900	I-8
3	50	Wagner	440	850	——
1	50	West.	440	850	CCL
1	50	West.	440	650	CCL
2	50	West.	220	600	CS-752C
1	50	G. E.	220/440	1200	H1
1	50	West.	440	690	C
1	50	G. E.	220/440	450	I
1	50	G. E.	220/440	400	I

A.C. MOTORS—3 ph. 60 cy.—con't

No.	Hp.	Make	Volts	RPM	Type
1	50/60	West.	440 only	1800	MS
1	50/60	G. E.	440	1200	I
1	50/100	West.	440	345/700	CS
1	54	Al. Ch.	440	900	——
1	60	Al. Ch.	440	1200	——
1	60	West.	440	900	C
2	60	West.	220	720	CS
2	60	G. E.	550	600	I-10
2	60	Triumph	220	430	C16
6	60	Al. Ch.	440	1800	AN
1	60	G. E.	220	720	I-8
1	60	Cr. Wh.	220	670	122Q
6	65	Al. Ch.	440	1800	AN
3	65	G. E.	440	1800	KT-347
1	75	W. El.	440	1800	CS
1	75	Wagner	440	1800	——
4	75	Al. Ch.	440	1800	AN
1	75	West.	440	1200	MS
1	75	G. E.	220/440	1150	I-8
1	75	U. S. Mtr.	220/440	900	SC
1	75	West.	220	600	CS
1	75	G. E.	220	900	I-8
1	75	G. E.	440/550	720	I-10
1	75	Cr. Wh.	220	514	124Q
1	100	U. S. Mtr.	220/440	1160	SC
2	100	G. E.	550	900	I-10
1	100	West.	220	720	CS
1	100	G. E.	2200	450	I
1	100	West.	220	1750	——
1	100	G. E.	220	1200	I-8
1	100	Al. Ch.	220	600	——
1	100	Cr. Wh.	220	575	124QB
1	100	G. E.	440	400	I-K
2	100	West.	220	1200	CS-Vertical
1	100	West.	240	900	——
1	100	G. E.	2300	580	I-15
1	125	West.	2300	1170	CS
1	125	G. E.	440	514	I
1	125	G. E.	440	450	I
1	125	G. E.	220/550	400	I
1	125	Wagner	440	1800	——
1	125	Cr. Wh.	220	720	124QB
1	125	Al. Ch.	2200	1165	ARV
1	150	West.	2200	720	——
1	150	G. E.	220/550	514	I
1	150	G. E.	440	600	I
1	150	G. E.	440	514	I
1	150	G. E.	220/550	450	I
1	150	Wagner	440	1800	——
1	150	G. E.	550	575	I-K
1	150	G. E.	2200 220/440	450/243	——
1	150	West.	2200	327	LC
1	150	G. E.	2200	600	I-12
1	200	G. E.	440	900	KT
1	200	West.	220 or 440	720	——
1	200	G. E.	220/550	600	I
1	200	G. E.	220/550	514	I
1	200	West.	2200	900	CS-967A
1	200	West.	220	580	CS
4	200	Al. Ch.	2300	347	AN
1	225	G. E.	2200	200	syn.
1	250	West.	2200	1200	——
1	250	G. E.	2300	1755	KTF
1	250	G. E.	220/550	720	I
1	250	G. E.	440	1200	Open
1	250	G. E.	2200	1175	I-8
1	280	West.	2200	450	Syn.
1new	300	West.	440	1200	——
		(Ball bearing — Acid Resisting)			
1	300	G. E.	2200	600	ATI-12
1new	400	West.	2300	580	CW
4	400	West.	2200/220/440	500	CS
1	800	G. E.	6600	1200	——
2	1000	G. E.	2300	509	K
1	9000	G. E.	6600	107	ATI

SLIPRING MOTORS—3 ph. 60 cy.

NO.	HP	Make	Type	Volts	RPM
1	1500	West.	CW	2200	435
1	400	West.	CW	440/220	1170
1	400	West.	CW	2200	435
1	350	West.	CW	2200	900
1	260	Burke		220/440	600
1	250	West.	CW	2200	345
1	100	G. E.	I	220	45
1	100	West.	CI	220/440	1750
1	75	Cr. Wh.		220/440	875
1	60	Triumph	C-16	220/440	430
1	60	West.	HF	2200	690
1	53	G. E.	I	220/550	1165

TRANSFORMERS—1 ph. 60 cy.

No.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G. E.	
1	100	2200	110/220	G. E.	
3	100	6600	550/440/220	Pgh.	
2	75	2200	220	Burke	8 ph.
3	50	11430/6600		Al. Ch.	
3	50	6600	575	G. E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West. (Rotary)	
1	30	2200	110/220	G. E.	
2	30	440	220/110	West.	
35	10	2200	110/220	G. E.	
40	10	2200	110/220	West.	
100	7½	2200	110/220	G. E.	
50	7½	2200	110/220	West.	
50	5	2200	110/220	G. E.	
75	5	2200	110/220	West.	

VARIABLE SPEED MOTORS—230 V. D.C.

No.	Hp.	Make	Type	RPM
1	35	West.	sk-140	675/1350
1	30	West.	sk-123	850/1700
1	30	G. E.	RLC	450/900
4	20	West.	sk-IOOL	750/1500
2	10	G. E.	le	625/1250
1	5	G. E.	CD-85	450/1800
2	3	Jants Liest	BI	650/1950
3	2½	G. E.		500/1000
1	2	West.	SK-63	300/1800
1	2	West.	SK-23	700/2100
1	½	Northern		700/2100

25 MOTORS 220/440 V. A.C.

Qu	HP	Make	Type	RPM
1	75	G. E.	I-4	900
1	75	Allis-Chalmers	AN	900
6	40	Allis-Chalmers	AN	900
1	35	Western Elec.	8L13B	500
1	35	West.	M	900
1	30	West.	C	720
7	30	Allis-Chalmers	AN	900
2	25	West.	MS	715
9	10	Allis-Chalmers	AN	900

DIESEL ENGINE GENERATOR SET

217 KVA, G.E. 2300/3/60 dir. con. 260 HP Buckeye 2 cyl. 200 rpm. semi-diesel engine complete.

INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractor 2000 lb. with batteries.
1—Baker Tow Truck with batteries.

PUMPS

1—2" gasoline driven portable Sterling Machy. Co.

CRANE

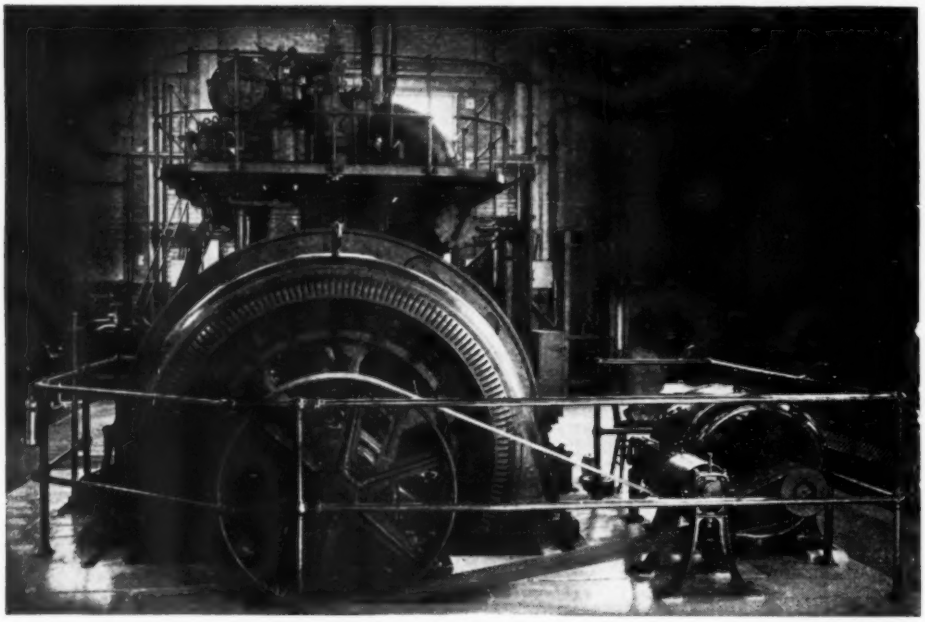
1—20 ton Whiting Crane 36'10" span motor driven lift, hand power.

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

450 KVA DIESEL ENGINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

450 KVA General Electric; 2 or 3 phase, 60 cycle, 2300/550/440 volts, 200 RPM alternating current generator direct connected to Busch-Sulzer vertical full Diesel engine complete with auxiliaries. A#1 operative condition—still on original foundation for operating test.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

7500 KVA Westinghouse condensing 200 lb. pressure, 2300 volts, 1800 RPM complete with either surface or jet condenser.

6250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser.

3125 KVA—2500 KW 80% P.F., G.E. 2300 volts, 3600 RPM, 180-200 lbs. pressure, 500 degree total temperature, equipped with surface condenser, condensing auxiliaries, panels and instruments. A complete installation.

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937 KVA Allis condensing 150-200 lb. pressure, 475° T.T., 2300 volts, 3600 RPM complete with direct connected exciter, surface condenser and auxiliaries.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH. 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser.

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14 x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switch board.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgway Unaflow non-condensing engine.

300 KW Westinghouse, 250 volts, 175 RPM generator direct connected to a 24" x 26" Skinner Unaflow non-condensing engine.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

312 KVA Elliott 4000/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

219 KVA G.E. 440 volts, 225 RPM generator direct connected Skinner Unaflow engine.

135 KW 80% P.F., G.E. 440 volts, 225 RPM generator direct connected Ames Unaflow engine.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

MOTORS

—3 phase, 60 cycle

250 HP (2) G.E. form M, 440 volts, 450 RPM three bearing slip ring.

150 HP (5) G.E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy. 440 volts, 400 RPM synchronous.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

SPECIALS

2000 KVA G.E. 3 phase, 60 cycle, 480 volt, 300 RPM alternating current generator.

1200 KVA G.E. 3 phase, 60 cycle, 2400 volts, 300 RPM alternating current generator direct connected to a 1700 HP, 3 phase, 25 cycle, 2300 volt synchronous motor.

750 HP, 28" x 32" Skinner, 150 RPM Unaflow belted type engine, 125 to 155 lb. pressure at throttle, 20 to 30 lb. gauge back pressure.

750 KW (2) G.E. synchronous rotary converters, 600 volts direct current, 6 phase, 60 cycle alternating current, 1200 RPM.

SPECIALS

(Continued)

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters—a complete installation—modern and practically new.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

330 KW G.E. synchronous rotary converter 600 volt direct current—6 phase, 60 cycle alternating current—1200 RPM with 2300 to 408 volt transformers.

200 KVA Westinghouse 3 phase, 60 cycle, 240 volt, 200 RPM engine type generator.

1055 cu.ft. 100 lb. air pressure Chicago Pneumatic horizontal compressor direct connected to 170 HP, 240 volt, 150 RPM G.E. direct current motor.

SYNCHRONOUS CONDENSERS

1350 KVA Total Capacity

750 KVA and 600 KVA G.E. type ATI, 3 phase, 60 cycle, 240 volts, 900 RPM synchronous condensers each complete with direct connected exciter, switchboard panel with instruments. Are in A#1 operative condition—still on original foundation for operating test.

Utilities Electrical Machinery Corporation

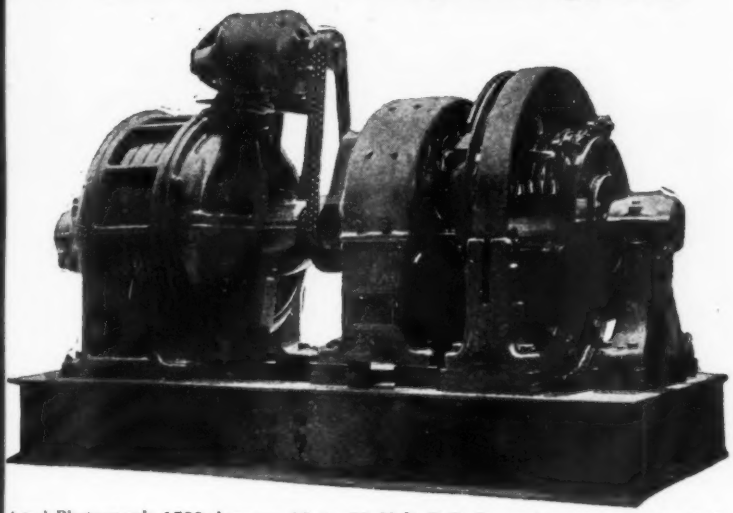
600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

Delivery from Stock!

GENERATORS

Anodizing, Electroplating, etc.



Actual Photograph 1500 Ampere 10 to 50 Volt D.C. Generator separate excited, driven by 3 phase, 60 cycle 220/440 Volt A.C. Motor

1—3200 Ampere General Electric
10 to 60 Volts

1—3200 Ampere Westinghouse
7½ to 30 Volts

2—1600 Ampere General Electric
10 to 60 Volts

3—1600 Ampere Westinghouse
7½ to 30 Volts

3—800 Ampere Westinghouse
7½ to 60 Volts

With A.C. or D.C. Driving Motors
Separate Excited
FULL RANGE VOLTAGE VARIATION

40 H.P.
Reliance Variable Speed Motor Drive

with

60 H.P. 3 ph. 60 cy. 220/440 v. A.C. Motor Driving 40 K.W. A.C. adjustable speed control unit.

MOTOR: 40 H.P. 250 V. Speed
150 to 1500 R.P.M.

Push Button Remote Control Throughout

1 Year Guarantee!

Completely Shop Reconditioned and Tested Before Shipment

New York City's Largest Stock Electrical Equipment

L. J. LAND & CO.

146 GRAND ST. *CAnal 6-6976* **NEW YORK, N. Y.**

READING, PA
10TH AND EXETER STS.

YORK, PENNA.
227 NORTH GEORGE ST.

PARTIAL LIST ONLY!!

230 VOLT DC MOTORS

H.P.	Make	Speed
300	G. E.	1100
150	West.	600
60	Roth	600
60	G. E.	480/1100 (2)
50	West.	550/1100
50	Cr. Wh.	700 (2)
50	G. E.	850
45	Diehl	850/1020
45	G. E.	1800
40	Cr. Wh.	915
35	West.	1150
35	G. E.	440/1800
25	West.	300/1200
25	Diehl	850/1020
25	G. E.	1150
25	Rel.	1150
25	G. E.	575
20	Cr. Wh.	1750
20	G. E.	1200
20	R. & M.	1160
20	G. E.	1150 (4)
20	West.	1150
20	G. E.	1150
20	G. E.	800 (2)
15	Star	1450
15	West.	1250
15	G. E.	1250
15	Eck	1100
15	G. E.	1150 (3)
15	G. E.	1150 (3)
15	Cr. Wh.	900/1800
15	West.	850
10	Rel.	1750
10	West.	850 (2)
10	G. E.	825 (3)
10	G. E.	700
10	Diehl	1750
10	Al. Ch.	600/1800
10	West.	600/1200
10	G. E.	400/1600
10	West.	400/1200 (2)
9	Al. Ch.	1750
9	G. E.	450/1800
8½	Diehl	900
8½	West.	850
8½	West.	350/1400
8	G. E.	500/1500
7½	Sturt.	3600
7½	Peer.	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G. E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. D.	550/1650
7½	Watson	525/1150
7½	G. E.	450/1800
7½	G. E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G. E.	300/1200
6	G. E.	400/1200
6	G. E.	850
6	G. E.	450/1800 (2)
5½	West.	500/1500 (2)
5	West.	850
5	G. E.	900 (2)
5½	G. E.	400/1600
5	West.	1800
5	G. E.	1700
5	G. E.	1150 (2)
5	West.	1160
5	Al. Ch.	1150
5	Cont.	600/1800
5	West.	850
5	G. E.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G. E.	450/1800
5	G. E.	600
5	G. E.	450/1350
5	West.	400/1200
5	El. Dy.	235/1100
4	G. E.	850/1150
3½	West.	850/1600
3	G. E. & West.	1700 (5)
3	G. E. & West.	1150 (6)
3	Roth	500/2200
3	G. E.	500/1500
2½	West.	480/1800

325–230 volt DC Motors down to 1/20 H.P.

115 VOLT DC MOTORS

H.P.	Make	Speed
20	West.	200/900
15	West.	1100
15	Cr. Wh.	800
10	Lo. All.	3500
10	G. E.	1150 (3)
10	West.	1150
10	West.	850
10	El. Dy.	425/1275
7½	G. E.	850 (2)
6	Burke	650
5	Cr. Wh.	1875
5	Col.	1500
5	West.	1100 (2)
5	Cr. Wh.	960

75 additional 110 volt Motors down to 1/6 H.P.

3 PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
200	G. E.	600
147	West. 25 cycle	715
100	G. E.	900
100	West.	720
100	G. E.	580
75	West.	870
50	Al. Ch.	690
40	G. E.	900
35	G. E.	1200
35	Wagner	850
30	U. S.	3450
30	West.	1750
30	Al. Ch.	850
30	Al. Ch.	600
25	Wagner	1200
25	West.	1140
25	Diehl	865 (5)
25	G. E.	900
25	Wagner	720
20	G. E.	1750 (3)
20	G. E.	1200 (2)
20	Cr. Wh.	1200 (2)
20	Al. Ch.	900 (2)
20	Diehl	900 (3)
20	G. E.	720
20	West.	1720
15	G. E.	3600
15	Cr. Wh.	1700
15	G. E.	1200 (3)
15	G. E.	900 (3)
15	Wagner	720
15	G. E.	600
10	G. E.	720 (5)
10	G. E.	3450
10	West.	1150
10	G. E.	900
7½	G. E.	3450
5	West.	900

40 additional three phase Motors down to ¼ H.P.

2 PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
75	Cr. Wh.	870
50	Line.	900
50	G. E.	900
40	G. E.	900
40	Al. Ch.	900
35	Al. Ch	900
30	West.	1200
25	G. E.	1200
20	West.	1150
20	Star	1150 (2)
15	West.	3450
15	G. E.	1200
15	F. & M.	900
10	G. E.	1200
10	G. E.	900
7½	G. E.	900
7½	G. E.	600/1350
5	G. E.	900
5	Al. Ch.	1200

40 additional two phase Motors down to ¼ H.P.

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Century	1165
15	Century	1720
7½	Century	3500
7½	West.	1750

8 additional single phase Motors

SLIP RING MOTORS

H.P.	Make	Speed
500	Al. Ch.	1180
250	G. E.	600
200	West.	720
200	G. E.	495
150	Al. Ch.	720
125	West.	1200
125	Burke	600
75	Al. Ch.	575
75	West.	1200
60	West.	1200
60	Al. Ch.	600
60	West.	290
50	Ideal	1740
50	G. E.	900 (3)
40	Wagner	1200
40	F. M.	900 (2)
40	West.	900
40	Line.	720
30	G. E.	720
30	G. E.	1200
25	Al. Ch.	900
25	Wagner	1200
25	G. E.	600
20	G. E.	900
20	West.	600
15	G. E.	900

33 additional slip ring Motors down to 1 H.P.

HEAT and POWER

TURBO GENERATOR SETS

1—750 KW Ridgway, 1800 RPM turbine, mixed pressure 135# Gauge 15# Absolute with C. H. Wheeler 2 Pas. surface condenser, direct coupled to a 250 Volt DC Generator 750 KW 1800 RPM.

SPEED REDUCERS

4—15 H.P., W. A. Jones Spur Gear TE.
4—10 H.P., W. A. Jones Spur Gear TE.

Babcock & Wilcox STEEL SERPENTINE HEADER BOILER TUBE SECTIONS

45 Sections each consisting of 12—4 x 20 ft. #9 gauge tubes, oval hand hole fittings, with gaskets ASME and National Board 200 lb. construction (Like NEW) also 9 sets of dusting doors.

BOILERS

2—684 HP Edgemoor Waste Heat Boilers, 200 lbs. pressure complete with Economizers, Super Heaters, motor driven blowers and steel stacks.

All above completely rebuilt and guaranteed

TRANSFORMERS

60 cycle, single phase

2—500 Kva Maloney 2300/230/115 oil cooled
3—100 Kva Pitts. 2400/240/120 oil cooled
4—5 Kva Wsghse 2300/230/460 air cooled
6—3 Kva Gen. Elec. 2300/230/115 air cooled

MOTORS

230 V. DIRECT CURRENT

Q	H.P.	Make	Type	R.P.M.
1	450	AL. CH.	INT.	425
1	150	G. E.	RC	1750
1	100	RELIANCE	1050 T	500
1	125	G. E.	DLC	550
1	100	WSGHSE	SA	250
1	75	WSGHSE	SK	1750
2	50	WSGHSE	SK160	565

3 PH. 60 CYCLE AC. 220/440 VOLT SQUIRREL CAGE

1	125	CR. WH.	125Q	900
1	100	GEN. ELEC.	IK	514
3	30	WAGNER	19VRM	720
1	50	WAGNER	22VRM	600
1	40	RELIANCE		900
2	20	RELIANCE	120AA	900
1	20	U. S.	B.B.	720
5	15	RELIANCE	C404	900
1	15	CENTURY	SCN19BB	1200

SLIP RING—440 Volt

1	150	WSGHSE 2200/550/440/220 volts	HF	495
2	150	Al. Ch.		600
1	30	GEN. ELEC. IM		900
1	25	GEN. ELEC. IM		900
1	15	GEN. ELEC. ITC		900

SYNCHRONOUS

1	350	GEN. ELEC.	2300	600
2	200	WSGHSE	2200 Volt	900
1	125	WSGHSE	2400	900
1	105	Electric Machinery	2200 Volt	1800
1	75	Gen. Elec.	220 Volt	900

Hundreds of other motors from 1 H.P. up

PUMPS

2—Davidson 14 x 9¼ x 16 Simplex Double acting Piston pattern, brass fitted.
1—Warren 14 x 8½ x 12 Duplex brass fitted.
1—Blake 14 x 8½ x 10 Simplex.

GENERATORS

230 V. DC

45 KW Diehl K 18 550 RPM.
100 KW Ft. Wayne MPL 550 RPM.
100 KW GE MPL 600 RPM.
200 KW Sprague 525 RPM.
200 KW West. 500 RPM.
250 KW West. 500 RPM.

CONDENSER

1—C. H. Wheeler 3650 Sq. Ft. Surface Cond 2 pass, complete with pumps.

STOKER

1—Jones, 3 retort, steam actuated, underfeed ram stoker.

STEEL TANKS

400,000 gal. Steel Water Storage Tank. 40' high 40' dia.

• TUBES

5000 CONDENSER TUBES

Condenser Tubes 1" OD 20 Gauge Admiralty 18 ft. long, like new.

BOILER TUBES
212 New Seamless

3½" 10 ga. boiler tubes 17'1" long.

Thousands Feet of Conduit ¾" to 3"

Write for Bulletin #P-100

PUMPS

Cameron Centrifugal

Purchased New 1923

Bronze fitted, mounted on common sub-base for motor drive—

1—Size 14—700 RPM 4700 GPM 35' head 60 HP
1—Size 14—720 RPM 5500 GPM 30' head 75 HP
1—Size 16—850 RPM 8500 GPM 45' head 125 HP

All Pumps Tested Hydrostatically For 125#

All Double Suction Volute, Gate Valves Attached

(1) Steel Plate Barometric Condenser

Pumps Handled Fresh Water From Spray Ponds.

HEAT and POWER Company, Inc.

45 BOND STREET Phone: ALgonquin 4-3874 NEW YORK, 12, N. Y.

"HEAT and POWER"

COMPLETE BOILER HOUSE

Consisting of:

BOILERS

4—1010 H.P. Watertube boilers, 250 lb. pressure, steel headers, longitudinal drums. ASME Code design—complete with oil burning equipment, pumps, Foster superheaters and accessories.

Building also available

5—316 H.P. Heine Watertube boilers, 160 lb. pressure, hand fired.

FEED WATER HEATER

1—COCHRANE Feedwater Heater 5000 H.P., open type.

WATER WHEELS and GENERATORS

2—45" HERCULES Cylinder Gate Type B Water Wheels. Complete with Governors pumps, and tanks. Each direct-connected to a WESTINGHOUSE ELECTRIC Verticle Generator 800 KVA, 3 ph., 600 V. 40 cy. 150 R.P.M.

FIRE PUMP

1—1500 G.P.M. Underwriters Fire Pump, Worthington Type 8 CLSD, 160 lb. pressure, 1750 R.P.M. direct coupled to 200 H.P. Terry Turbine.

OVERHEAD CRANE

1—15 Ton, OVERHEAD CRANE, 50 ft. span overhead Travelling Crane, Electric lift, hand travel.

MOTOR GENERATOR SET

1—35 KW GENERAL ELECTRIC Motor Generator Set. 125 Volt D.C., 1200 R.P.M., R.C. Generator; Motor General Electric KT, 550 Volt, with compensator and D.C. Panel.

AIR COMPRESSOR

Chicago Pneumatic Air Compressor, Motor Driven, duplex Horizontal 12 x 6 x 10, 327 C.F.M., 125 lb. pressure. 250 R.P.M. Complete with Intercooler, Idler, Air Receiver and Motor.

HEAT and POWER Company, Inc.

45 BOND STREET Phone: ALgonquin 4-3874 NEW YORK, 12, N. Y.

DEPENDABLE

Turbo-Generators

A PARTIAL LIST OF OUR INVENTORY

1—G.E. 3125-KVA, 3600-RPM, Condensing: 3/60/2300-v, 200#, 100° SH, 28" vacuum: Surface or Low Level Jet Condenser.

1—Westinghouse 2500-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Low Level Jet Condenser.

1—G.E., 1875-KVA, 3600-RPM, Condensing: 3/60/600-v, 200#, 100° SH, 28" Vacuum: Surface or Jet Condenser.

1—G.E., 1563-KVA, Non-condensing 3600-RPM, 3/60/600-v: 150#, 100° SH, 20# back pressure.

1—Allis-Chalmers 1250-KVA, 3600-RPM, 3/60/2300-v, 200#, 500° TT: Surface Condenser.

1—Westinghouse, 1250 KVA 250-v, direct current, condensing, 150/250-Lbs., Surface Condenser.

1—Allis-Chalmers 937-KVA, 3600-RPM, Condensing: 3/60/2300-v. 200#, 500° TT: Surface Condenser.

1—G.E., 625-KVA, 3600-RPM, Condensing: 3/60/2300-v. 200#, 500° TT, 28" vacuum.

1—G.E., 250-KVA, Non-condensing, 3600-RPM: 3/60/480-v, 150#, 0° SH, 28" Vacuum, 10#G, back pressure.

WILMS, WEAVER & CO. Penobscot Building DETROIT, MICH.

We Deal in Turbo-Generators Exclusively

CHICAGO ELECTRIC—GUARANTEED REBUILT EQUIPMENT

MOTOR-GENERATOR SETS

KW	Make	DC volts	AC volts
1000	G.E.	600	4400/2200
1000	Wtg.	275	4160/2300
750	G.E.	275	440
300	Al. Ch.	600	2300 syn.
250	G.E.	600	
200	3-unit	80v.DC	250 v. DC
235	Westg.	110	2200
225	Ideal	115	2200
200	Westg.	250	440/2200
150	Cr. Wh.	250	2300
150	Ideal	250	440
150	Rdg.	250	2300
100	G.E.	250	2200
100	Westg.	125	2200
100	Al. Ch.	125	440
100	Westg.	250	220/440/2200
90 HP	Westg.	110	75 Kva 2200 ac
75	G.E.	250	2200
75	G.E.	125	220
50	Al. Ch.	3-w.	2200
50	G.E.	125	4000
50	Westg.	250	2300
15	G.E.	230	220
15	Ster.	240	220
7½	Jenny	balance set	

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	20	G.E.	MT-503	1710
1	20	G.E.	I-M10A	1800
1	20	G.E.	I-M11	1140
1	20	Allis Ch.	ARY	1145
1	25	G.E.	I-M10	1730
1	25	Wtg.	CW556A	1160
1	25	G.E.	MT326	1145
1	25	Century	SR405	1170
1	25	G.E	MT526	840
1	25	G.E	MT-342	570
3	30	G.E.	MT-526	1150
1	30	G.E.	MT-342	565
1	30	Wagner	BR	850
1	30	Wtg.	HF10A	860
1	18/35	Westg.	CW654C	575/1150
1	30/15	G.E.	OMT336	1155/550
1	35	F. Mse. vert.	UVA	1800
1	35	G.E.	I-M13	600
1	35	G.E.	I-M-13	600
1	40	G.E.	MT-int.	1200
1	40	Wagner	22TBR	1725
1	40	Westg.	CW	1160

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300 Form C, 3 ph. 50 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. synchronous motor with amort. wdg., dir/conn. to 1000 KW General Electric types ATI-10-1250M-300, 3 ph. 25 cy. 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. A.C. generator with amort. wdg., with 33 KW G. E. 125 volt direct connected exciter. This is a three brg. unit suitable for operation from either end.)

25 CYCLE—M. G. SETS

1—74 KW General Electric type CL6, 126 v., compound wound, D.C. generator, 2 brg., dir. conn. to 110 HP type I-K, 3 phase, 25 cycle 230 v., 750 RPM sq. cage motor.

1—75 KW General Electric type DLC-206A, compound interpole, 3 brg. D.C. generator, dir. conn. to 115 HP type I-K, 3 phase, 25 cycle, 440 volt, 750 RPM, sq. cage motor.

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	40	Wagner	BR	850
1	40	Westg.	HF	690
1	50	Westg.	HF11AH	1180
1	50	Al. Ch.		1160
1	50	Wst.	HF	860
1	50	F.M.	HV	720
1	50	Westg.	CW752C	690
1	50	G.E.	I-M	685
1	50	Al. Ch.	ARY	690
1	50	G.E.	I-M	600
1	50	Wtg.	CW855	570
1	50	G.E.	MTC5342	565
1	50	Al. Ch.		720
1	60	Westg.	CW	600
3	75	Al. Ch.	ARY	900
1	75	Westg.	F	720
1	75	G.E.	M-12	600
1	75/94	N. West	HW	1800
1	100	G.E.	I	600
1	100	Al. Ch. 2200 v		600
1	100	Westg. 2200	CW	600
1	100	Westg.	HF	230
1	150	G.E.	MT	900
1	150	Westg.	CW	600
1	150	Al. Ch.		580
1	150	Wagner	BR	1140
1	150	Westg. 2200	CW	375
1	200	G.E.	IE	1200
1	200	Howell	S	600
1	200	Westg.	CW	345
1	250	Al. Ch. 2200/400		600

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	250	G.E. Slipring vert		1200
1	300	G.E. Slipring	I-M2200	514
1	300	G.E., 3-brg.	MT-410	450
1	300	G.E. with out-board brg.	I-P	450
1	350	G.E.	MT-432V-	300
1	350	Allis C.		300

SQUIRREL CAGE

Qu.	HP	Make	Type	Speed
4	25	G.E.	I-K	1200
3	25	West. Elec.	I-K	1200
1	25	Watson	KH-12	1140
1	25	G.E.	KT-326	1165
1	25	Cleveland	MG-475	1200
1	25	G.E.	KT-332	900
1	25	Wagner	22TBR	860
1	25	G.E.	KT-332	900
1	25	G.E.	KT-336	690
1	25	Westg.	CS675A	570
1	35	Westg.	CS	1170
1	30	G.E.	FT-532	870
2	30	Wagner	BW-BP	850
1	30	G.E.	KT336	900
1	30	F. Morse		900
1	30	Allis Chal.	AR220V	865
1	30	G.E.	I-K	690
1	35	Allis Chal.		480
1	40	G.E.	KF-444Y	1745
1	40	Al. Chl. 2200	AR220A	1750
1	40	Allis Ch.	AR	850

SQUIRREL CAGE

Qu.	HP	Make	Type	Speed
1	40	F. Morse bb	H 2200v.	720
1	40	Allis Chal.		570
1	50/60	G.E. vert.	I-K	3600
1	50	Wagner	BP	1140
1	50	Wetg.	CCL	850
1	50	G.E.	I-K	720
1	50	G.E.	I-K	490
2	60	Wtg. bb 2200 v.	CS	1750
1	60	Wtg.	CS	435
1	60	Westg. (B.B.)	CS	435
1	75	G.E. vert hollow shaft		1800
1	75	Westg. 2200 v.	CS	1800
1	75	Westg.	CCL	850
1	75	G.E.		720
2	75	Westg.	CCL	690
1	75	Westg., double shaft ext.	MS	680
1	75	Al. Ch.	AN	680
3	75	Al. Ch.	345	
5	75	G.E.		600
1	100	Al. Ch.		1800
1	100	Al. Ch., vert.		1200
3	100	Westg., 2200/220/440	CS	1200
1	100	West El.	KT	900
1	100	G.E., 2200 v.	IK	900
1	100	Al. Ch., 2200 v.		450
2	125	G.E., 2200 v.	KT547	1800
2	125	G.E., 2200 v.	KTP	1800
4	125	G.E.	KT	720
1	150	Westg., 2200 v.	CS	1710
1	150	Al. Ch.		1200
1	150	G.E.	K-558	900
1	150	Westg., 2200 v.	CS	1800
1	150	G.E.	IK	600
2	150	Westg.	CCL	495
1	200	Westg.	CS	3600
3	200	F. Morse, B.B.		1800
1	200	G.E., 2200 v.	KT	1800
1	200	G.E.	IK	1200
1	200	G.E.	IK	600
1	200	Westg.	CS	600
1	225	G.E., 4160 v.	FT	3600
1	225	G.F., 2200	I-E	1800
4	250	Fair, M.B.B., 2200 v.		1800
1	250	Ideal	A	1200
1	250	F. Morse B.B.	3-brg.	900
2	400	G.E., 2200 v.	I-K	1800
1	400	Al. Ch.		600
1	700	G.F., 2200, drip-proof constr.	KF	1800
1	1000	G.E., 2200 v.	K	500

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO, ILL.

"GET IT FROM POWER"

EQUIPMENT COMPANY

SPECIAL

1—25 K.V.A. Diehl A.C. Gen. 240 V., 60 Cycle, 3 Phase, 1800 R.P.M., with Belted Exciter on Base direct connected to 38-Buick Engine, can be used by gasoline or natural gas, all complete. FOB Rochester.

We also have in stock all kinds of—

TRANSFORMERS
COMPENSATORS
OIL CIRCUIT BREAKERS

All types of—
SWITCHBOARD EQUIPMENT

Generator Sets—ALL— voltages and speeds.

Send full details of Unit desired. Will quote.

SPECIAL

1—200 HP, West., CW, Slip Ring

MOTOR

220 V, 60 Cyc., 3 Phase, 1200 RPM

also

1—35KW, MG SET

GE, 125 V, 1200 RPM, Direct connected to a 50 HP motor

IMMEDIATE SHIPMENT

MOTORS—SQ. CAGE

3 Phase—60 Cycle—220/440 Volt

100 Motors up to 15 HP — all makes and types and speeds.

Qn.	H.P.	Make	Type	Speed
1	15	West.	CS	1800
1	15	G.E.	KT	1200
1	15	G.E.	KT	900
1	20	G.E.	KT 302	1800
1	20	G.E.	KT 312	1200
1	25	G.E.	KT 30N	1800
2	25	West.	CS	1200
1	25	G.E.	KT 332	900
2	25	Line.	Nema	600
1	30	G.E.	KT 312	1800
1	30	West.	CS	1800
2	30	West.	CS	1200
1	30	G.E.	KT 336	720
1	40	G.E.	KT 323	1800
1	40	G.E.	KT 336	900
1	50	G.E.	KT 327	1800
1	50	West.	CS	900
1	50	G.E.	KT	720
1	60	G.E.	KT 333	1800
1	75	G.E.	KT 337	1800
1	75	G.E.	KT	900
1	75	G.E.	IK	720
1	100	G.E.	IK	900
1	100	G.E.	KT	514
1	125	Cr. Wh.	SC	900
1	150	West.	CS	1800

Also larger Units available. Mail your inquiries. We also carry in stock a large number of 2300 V. motors. All types, makes and speeds. Mail us your inquiries on these machines.

MOTORS—SQ. CAGE

3 Phase—25 Cycle—220/440 Volt

50 Motors in stock up to 15 HP. Send details, we will quote

Qn.	H.P.	Make	Type	RPM
4	20	West.	CS	750
1	25	West.	CS	1500
1	25	G.E.	KT	750
1	30	G.E.	KT	750
1	40	Al.-Chal.	AR	1500
1	40	West.	CS	750
1	75	G.E.	IK	750
1	100	G.E.	IK	750
2	150	G.E.	IK	750

Also in stock many 2300 V. motors—also all types of 25 cycle Slip-ring motors, all types and makes.

MOTORS—SLIP RING

60 Cycle—3 Phase—220/440 Volt

25 Motors — In stock up to 10 H.P.— All Speeds and types.

Qn.	H.P.	Make	Type	Speed
1	15	G.E.	MT	1800
1	15	G.E.	MT 312	1200
1	15	G.E.	MT 312	900
1	20	G.E.	MT 322	1200
1	20	G.E.	MT 326	900
1	25	G.E.	MT 326	1200
1	40	G.E.	MT 332	1200
1	40	G.E.	MT 336	900
1	50	West.	CW	1200
1	50	Al.-Chal.	ANY	900
1	50	G.E.	MT 342	900
1	60	G.E.	MT 346	900
1	75	G.E.	MT 356	900
2	75	A.-Chal.	ANY	900
1	75	West.	CW	900
1	75	G.E.	IM	720
1	100	G.E.	MT 356	900
1	100	G.E.	IM	720
1	150	West.	HF	600
1	150	West.	CW	600
1	200	G.E.	IM	514

Also larger Units available.

MOTORS—SLIP RING

60 Cycle—3 Phase—2300 Volts

Qn.	H.P.	Make	Type	Speed
1	75	G.E.	MT 300	900
1	100	G.E.	IM	600
1	150	G.E.	IM	600
1	200	G.E.	IM	720
1	200	G.E.	IM	600
1	300	G.E.	IM	600

All types of Slip Ring controls in stock.

D.C. VARIABLE SPEED MOTORS

230 Volts

25 Motors up to 10 H.P. Any speed range.

Qn.	H.P.	Make	Type	Speed
1	10	West.	SK	500/1500
1	10	West.	SK	250/1000
1	10	G.E.	RF 11	400/1600
1	15	G.E.	RF 10	550/1650
4	15	West.	SK	500/1500
1	20	G.E.	RF	400/1200
1	25	G.E.	RF 13	400/1200
1	25	West.	SK	300/1200
1	25	Rel.	131 T	800/1600
1	25	Rel.	155 T	500/1600
1	35	West.	SK	500/1500
1	50	G.E.	RF 14	500/1500
1	100	G.E.	MPC 6	300/600

D.C.—230 V.—MOTORS

50 Motors up to 10 H.P., all speeds and makes Send inquiries.

Qn.	H.P.	Make	Type	Speed
1	10	G.E.	RC 29A	1800
1	10	G.E.	CD	1800
4	10	West.	SK 60L	1200
2	10	G.E.	CD	1200
2	10	G.E.	RC	900
1	10	G.E.	RC	1200
1	15	G.E.	CD	1800
1	15	G.E.	RC	1200
2	15	West.	SK	1200
1	15	West.	SK	900
1	20	West.	SK	1200
1	20	West.	SK	900
1	25	West.	SK	1800
2	25	West.	SK	1200
2	25	G.E.	RC	900
1	40	West.	SK	1200
1	60	West.	SK	1800
1	75	West.	SK	1800
1	100	G.E.	CD	1200
1	150	West.	SK	1800

D.C.—115 V.—MOTORS

Qn.	H.P.	Make	Type	Speed
1	5	West.	SK 30	1200
1	5	West.	SK 284	1200
2	5	West.	SK	1800
1	7½	G.E.	RC	1200
1	10	G.E.	RC	1200
1	10	G.E.	RC	900
1	15	West.	SK	1200
1	15	West.	SK	900

Above partial listing, many others available.

A.C.—60 CYCLE—3 PHASE GENERATORS

KVA	Make	Type	Volts	RPM
25	Diehl	9	220	1800
50	G.E.	ATB-P	240	1200
75	G.E.	ATB	2300	900
100	G.E.	ATB-PB	2300	900
150	G.E.	ATB-P	240	900
180	G.E.	ATB-PB	240	600

POWER EQUIPMENT CO.

519 Case Building - 82 St. Paul Street

Post Office Box 183 — Rochester, New York — Telephone Main 569

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.

1—18750 KVA Westinghouse Cond.
1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 6000 KVA Westinghouse Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
2— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Westinghouse Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 1500 KVA Allis Chalmers Non-C.
1— 1500 KVA Westinghouse Non-C.
2— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 625 KVA General Electric Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 400 KW Ames Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 250 KVA Ridgway 4-valve
1— 250 KVA Ames Uniflow
1— 210 KVA Skinner Uniflow
1— 94 KVA Chuse Uniflow

D. C. STEAM ENGINE UNITS

1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Ridgway 4-valve 250 V. 3-wire
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire

OIL & GAS ENG. UNITS—60 Cy.

1—500 KVA West. (gas) 440 V.
1—312 KVA Anderson 2400 V.
1—200 KW Worthington 2300 V.
2—200 KVA Fairbanks Morse VA 2400 & 220/440 V.
1—187 KVA McInt.-Seymour 2300 V.
1—125 KVA Sterling Petrol (gas) 480 V.
1—121 KVA Fairbanks Morse 240 V.

WATER TUBE BOILERS

2—1452 HP B. & W. 350-lb., Stokers
1— 750 HP Edge Moor 200-lb.
1— 612 HP Stirling 200-lb., Pulverizer
1— 500 HP Stirling 250-lb., Stoker
1— 500 HP Stirling 200-lb., Stoker
1— 440 HP B. & W. 160-lb., Hand Fired
1— 400 HP Wickes 200-lb., Stoker
1— 333 HP B.&W. 200-lb., McClave-Brooks Stoker
4—200 HP B. & W. 200-lb., Hand Fired

SYNCHR. MOTORS—60 Cy.

1—1000 HP Westinghouse 2300 V. 720 RPM
1— 800 HP General Electric 440 V. 120 RPM
1— 750 HP Westinghouse 2300 V. 720 RPM
1— 200 HP General Electric 2200 V. 1800 RPM
1— 175 HP General Electric 230 V. 225 RPM
1— 175 HP General Electric 220 V. 200 RPM
1— 100 HP General Electric 2300 V. 240 RPM

INDUCTION MOTORS—60 Cy.

4—3500 HP G.E. slip ring 2300 V. 120 RPM
1— 600 HP G.E. sq. cage 440 V. 900 RPM
2— 400 HP G.E. slip ring 3800 V. 1800 RPM
2— 300 HP G.E. sq. cage 440 V. 600 RPM
2— 250 HP G.E. sq. cage 2300/4000 V. 1200 RPM
3—50-150 HP West. 2200 V. 343-679 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW General Electric 600 V. DC
1—1500 KW West. 250 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 500 KW General Electric 600 V. DC
1— 500 KW General Electric 250 V. DC
1— 75 KW General Electric 125 V. DC

ROTARY CONVERTERS—60 Cy.

1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 750 KW Westinghouse 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

OIL CIRCUIT BREAKERS

2— 600 A. 73 KV West. G222AS Outdoor
2— 400 A. 73 KV G. E. FKO36 Outdoor
1— 400 A. 73 KV G.E. FHKO-36 Outdoor
6— 400 A. 37 KV G.E. FHKO136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB-76 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
4— 600 A. 15 KV G.E. FKO-60-B Outdoor

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G.E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G.E. 25/60 cy. 300 RPM
1—1250 KVA G.E. 25/62½ cy. 750 RPM
1—1000 KW G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 25/60 cy. 300 RPM
1— 600 KW G.E 25/60 cy. 300 RPM

SYN. CONDENSERS

1—2000 KVA G.E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000-38000 V.
3— 200 KVA G.E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500/17250-4600/2300 V.
3— 75 KVA G.E. 33000/13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3— 1500 KVA Pitts. 22000-6600 V.
2— 1000 KVA G.E. 23000/11500-575 V.
6— 833 KVA G.E. 22000-2300/4000Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G.E. 22000-11000 V.
1— 5000 KVA American 13800-2300 V.
6— 1667 KVA Pitts. 13200-2300 V.
5— 1000 KVA G.E. 13200-2300 V.
3— 200 KVA G.E. 13200-2300 V.
7— 667 KVA Moloney 11000-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3—1250 KVA G.E. 6600-550 V.
3— 667 KVA G.E. 2300/4000Y-500/480/460 V.
5— 100 KVA G.E. 2300-230/460 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & Co., INC.

50 CHURCH STREET, NEW YORK CITY

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 Cycle, 220/440 V.

HP	Make	RPM	Type	Frame
5	West.	1200	CCL	2 phase
5	American	600	totally enc.	ball bearing
7½	Gen. Elect.	1800	KT	944
7½	Gen. Elect.	1800	KQ	944 2 phase
10	Fairbanks Morse	900	KBY	
10	Crocker Wheeler	900	ma	365
10	Burke	1800		
15	Reliance	1200		2 phase
15	Howell	900		2 phase
20	Gen. Elect.	1800	KQ501	2 phase
20	Gen. Elect.	565		Form K
25	Gen. Elect.	1740	KQ312	2 phase
25	Armor	1200	ball bearing	2 phase
25	Gen. Elect.	1800	KT	312
30	Gen. Elect.	3600	KT	513
30	Armor	695	ball bearing	2 phase
50	West.	1200	MS	
50	Fairbanks Morse	1800	ball bearing	
50	Fairbanks Morse	1800	ball bearing	
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Elect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

MOTOR GENERATOR SETS

1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.
1—150 KW Westinghouse SynchronousGenerator- 250/275 V. DC. Motor 3/60/2300/900 RPM complete with panels.

ENGINE TYPE MOTOR
625 Hp. Gen. Elect. Synchronous 3 Ph. 60 Cy., 2300 Volt, 180 Rpm.

Mine Slope Hoist

1—Connellsville Mfg. and Mine Supply Hoist —storage capacity for 11,000 feet 1" Rope— Speed 900' per minute.
Motor—500 HP Gen. Elect. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.
Write Wire Phone
Inspection can be made for 30 days in operation. This machine almost new.

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltage
3	25	Gen. Elect.	25	2300/115/230/460
3	40	Gen. Elect.	25	2300/230/460
3	50	Gen. Elect.	60	2300/230/460
3	250	Gen. Elec. (new)	60	13,200/2300
3	200	Kuhlman	60	4160/4600/230/460
3	500	Pittsburgh	25	11,500/220
3	1000	Pittsburgh	60	2300/4600/230/460

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
5	Al. Chal.	720	AR	
5	Wagner	1450	Ball B.	Enclosed
7½	West.	750	CS	
7½	G. E.	1500	KT	181
10	G. E.	750	KT	312
10	West.	750	CS	
10	West.	1500	CS	
10	G. E.	1500	I	Form K
15	G. E.	750	KT	
15	West.	1500	CS	
20	West.	750	CS	
25	West.	750	CS	
50	G. E.	750	I	Form K
50	West.	750	CS	
75	G. E.	750	KT	357
75	G. E.	750	I	Form K
100	G. E.	300	I 17	Form K
150	G. E.	750	I	Form K
150	G. E.	750	I	Form K
200	West.	460	CS	2200 Volt
200	G. E.	750	I	Form K
225	Elec. Ma.	500	2200 V.	Synchron
1150	G. E.	375	2300 V.	Synchron
200	West.	235	CW	Slipring

Prices on Application

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
500	Westinghouse	600	CW	

25 Cycle Steel Mill Motors

Amt.	HP	Make	RPM	Type	Voltage
1	225	Elect. Mach.	500	Synchronous	2300
2	750	Gen. Elect.	125	Slip Ring	2300
1	1000	Allis Chalmers	293	Slip Ring	6600
1	1150	Gen. Elect.	375	Synchronous	2300
1	1250	Allis Chalmers	294	Slip Ring	6600
4	1600	Gen. Elect.	93	Slip Ring	2300
1	2000	Allis Chalmers	294	Slip Ring	6600
1	2500	Allis Chalmers	295	Slip Ring	6600
1	2600	Allis Chalmers	146	Slip Ring	6600
1	3000	Allis Chalmers	184	Slip Ring	6600
1	5500	Allis Chalmers	370	Slip Ring	6600

FREQUENCY CHANGERS

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM, direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP, Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

150 HP D.C. MOTOR
150 HP. Westinghouse Type SK, 180L, 230 V., 1100 RPM, Compound Interpole. Serial No. 2221504.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

Let MacCABE lift your Worries!

GENERAL PURPOSE 230-VDC. MOTORS

H. P.	Make	Type	R. P. M.
1—½	C. W.	C. M.	400-SH.
1—11	C. W.	E	1200-SH.
2—2	Allis. Chal.	E-50	1750-SH.
2—3	Westgshe	CD-925	1725-SH.
1—3	G. E.	CD-55	1150-SH.
1—3	Reliance	T-224	3500-SH.
3—5	Westgshe	SK-40	850-SH.
2—5	Westgshe	SK-30	1100-Comp.
4—5	Westgshe	SK-30	1100-SH.
2—7½	Westgshe	SK-60	850-Comp.
1—7½	Westgshe	SK-40	1150-SH.
1—10	Westgshe	SK-50-L	1300-SH.
1—15	Allis. Chal.	Shunt	800
1—15	C. W.	Size 15-J	800-Comp.
1—15	G. E.	OD-75	1750-SH.
2—25	Westgshe	SK-100-L	100-SH.
2—25	Westgshe	SK-120	825-Comp.
1—40	Reliance	RH-992	200-Comp.
1—75	Westgshe	SK	850-Comp.

220/440-V. 3-PH. 60-CY. MOTORS CRANE AND GENERAL PURPOSE

1—3	Ideal	A. E. Crane	1600
1—3	G. E.	K. Q.-730	1730-(2-Ph.)
1—3	Wagner	11-V.R.P.	860
1—5	G. E.	K. Q.-946	1200
1—5	G. E.	M. T. C.-5201	675 (25-CY.)
1—7½	G. E.	K. T.-944	1800
1—10	F. M.	OS-FW-324	1740
1—10	F. M.	OLS-326	1200
1—10/20	G. E.	K. T.-5224	600/1200
1—11	Louis Allis.	Crane	1200
1—11	P. & H.	H. W.-10-A	820
1—15	Electro Dy.	F. R.-1601	1145
1—20	G. E.	1	1200
1—22	P. & H.	H. W.-20	840
1—25	F. M.	H	900
2—25	F. M.	H	1200
1—25	Westgshe	C. I.	690
1—25	Westgshe	C. S.	900
2—25	G. E.	K. T.-326	1160
1—30	Westgshe	C. I.	690
1—30	Westgshe	C. I.	1150
2—37	G. E.	I. T. C.-5011-A	700 (25-CY.)
2—35	Westgshe	C. I.-885	900
1—35	G. E.	1-form-K	1800
1—40	G. E.	ITC-5012	600
1—40	G. E.	K-444	1800
1—35	F. M.	H-12-B	1200
1—50	G. E.	KT-346	870
1—52	G. E.	ITC-5013	600
1—75	Westgshe	C. W.	820

230-VDC. CRANE & MILL MOTORS

H. P.	Make	Type	R. P. M.
1—1	P & H	5½x3½	850
2—2	Shaw	BE	930
1—2½	G. E.	C. O. 2502	750
1—2½ (New)	Reliance	T-224	1600
4—3	Shaw	BE	930
1—3½	G. E.	C. O.-2503	975
1—5½	G. E.	C. O.-2504	725
1—6	C. W.	M. L.	930
1—6	G. E.	C. O.-1805	1150
1—7½	G. E.	C. O.-1806	700
1—10	G. E.	C. O.-2503	850
2—10	G. E.	M. D.-102	700
5—11/15	Westgshe	K-5	700
1—19	C. W.	BW	650
1—20	G. E.	C. O.-2504	850
1—20	Westgshe	K-6	675
1—20/25 (New)	Westgshe	K-5	975/875
2—20/30	G. E.	M. D.-104	725/575
4—25	G. E.	C. O. 1809	550
2—65/85	G. E.	C. O.-1830	700/650
1—85	G. E.	C. O.-1811	550
1—150	Westgshe	MCB-100	365

WE HAVE IN STOCK 150-DRUM AND FACE PLATE TYPE REVERSING CONTROLLERS, MANY WITH RESISTOR BANKS: 6 TO 100-HP. ELECTRIC BRAKES. 115/230/550-VDC.

VARIABLE SPEED 230-VDC. MOTORS

1—2	G. E.	R. F.	500/2000-SH.
1—3	G. E.	RLC-111	750/1500-SH.
1—3¾	G. E.	RLC-112	600/1800-SH.
1—5	Reliance	Frame F	500/1800
1—5	Reliance	Frame F-943	450/1800
1—5	Westgshe	SK-33	150/1650-SH.
1—7½	Reliance	F-953	450/1850-SH.
1—7½	Reliance	G-903	275/1650-SH.
1—7½	Westgshe	SK-103	400/1600-SH.
1—8	Westgshe	SK-100-L	300/1200-SH.
1—10	Reliance	G-900	400/1200-SH.
1—70	Reliance	461-T	600/1200-SH.

(E.C. & AUTO PANEL WITH 70-HP. MOTOR)

AUTO CONTROL AVAILABLE FOR MOST THESE MOTORS

SPECIAL: 600-HP. G-E. Synchr. Motor, Type TS, 600-RPM. 2200/3/60-Cy., #4315876.

T. B. MacCABE COMPANY

4306 CLARISSA STREET PHILADELPHIA 40, PA.

Motor Generator Sets—Synchronous Motors, etc.

VERTICAL MOTORS

1—G. E. 50 HP 1200 RPM 3 ph 60 cy 220 V.
1—Reliance Fan-cooled 25 HP 1750 RPM 220/440 V.

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A.C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

Allis-Chalmers 250 HP 600 RPM 440 Volt
G. E. 60 HP 600 RPM 440 Volt
G. E. 62½ HP 1150 RPM 440/220 Volt

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220/1440 Volts

1—150 HP 1750 RPM Allis-Chalmers
2—100 HP 550 RPM Westinghouse MS
1— 75 HP 575 RPM Westinghouse CS—368-A
1— 75 HP 600 RPM Fairbanks-Morse
1— 75 HP 720 RPM Lincoln I-P
1— 65 HP 860 RPM Allis-Chalmers
1— 50 HP 1200 RPM Northwestern
1— 50 HP 690 RPM Westinghouse CS—758
1— 50 HP 875 RPM Westinghouse CS
1— 50 HP 865 RPM Ideal
1— 30 HP 1200 RPM Ideal
4— 20 HP 870 RPM West. T.E.F.C. CS—W-405
2— 20 HP 870 RPM West. CS—W-405
2— 15 HP 860 RPM Allis-Chalmers

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA, 277 RPM, 3 phase, 60 cycle

The Electric Motor & Repair Co., Cuyahoga Falls, O.

SAMPLE OF MANY FINE VALUES

3 unit 870 HP Diesel Plant, 3-60-2300 V.
420 HP Busch Sulzer, 270 and 180 HP Worthingtons, all in excellent condition.
520 HP Fulton 450 KVA Diesel Generator.
1500 ft. 100-150# Syn. M.D. Compressor.
168 KW 2300 Volt Skinner Uniflow
150 to 800 HP Steam Water Tube Boilers.
200 to 3000 KW Turbine Generators.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N.Y.

A C TURBINE UNITS

6250 KVA G.E. 2300 V. Cond.
5000 KVA Al. Chal. 4150 V. cond.
4000 KVA Al. Chal. 2300 V. cond.
3125 KVA G.E. 2300 V. Cond.
2500 KVA Al. Chal. 440 V. cond.
1875 KVA Al. Chal. 2300 V.; Cond.
1250 KVA G.E. 2300 V. cond.
937 KVA G.E. 2300 V.; Cond.
937 KVA Wghse. 6600 V.—250 lbs.
937 KVA Al. Chal. 2300 V.—300 lbs.
780 KVA Al. Chal. 2300 V.; Cond.
625 KVA Wghse. 2300 V.; Cond.
500 KVA Wghse. 480 V.; Non-Cond.
375 KVA G.E. 2300 V.; Cond.
375 KVA G.E. 2300 V.; Non-Cond.
312 KVA Elliot 480 V.; Cond.
312 KVA C.W.-Moore, Non-Cond. (450#)
175 KVA Al. Chal.-Sturtevant 220 V.;
112 KVA Al. Chal. 240 V.—Terry

STEAM ENGINE SETS

500 KVA G.E. 240 V.—Ames Unif.
500 KVA G.E.—Bates Corliss (AC)
490 KVA Wghse.—Hamilton Cross Comp. (AC)
450 KW C.W. 250 V.—Nordberg Unif. (DC)
420 KVA Wghse.—Erie Ball Cross Comp. (AC)
375 KVA G.E.-E.B. 4 Valve; 480 V.
300 KW G.E.-Skinner Uniflow; 250 V. DC
210 KVA G.E.-Skinner Uniflow; 480 V. AC
200 KW Elliot, 250 V., 3 W.—Elliot 4 V.
150 KW G.E. 250 V. 3 W.—Erie Ball 4 V.
150 KVA G.E.-Skinner; 220 V.
125 KW G.E.-E.B. 4 Valve; 250 V. DC
100 KW G.E.-E.B. 4 Valve; 250 V. DC
100 KW G.E.-E.B. 4 Valve; 125 V. DC
100 KW Elliot 250 V. 3 wire—Elliot 4 V.

SPECIAL — 937 KVA GENERAL ELECTRIC 3-60-2300 V. CONDENSING TURBO GENERATOR SET; EXCITER; SURFACE CONDENSER; SWITCHBOARD.

500 KVA Wghse. 3-60-480 V. Non-Cond. Turbine Unit, Exciter, Switchboard.

210 KVA G.E. 3-60-480 V. Alternator-19x20 Skinner Uniflow Engine; Exciter, Switchboard.

A C MOTORS

700 HP G.E. Slip Ring 150 RPM
650 HP G.E. Syn. 240 RPM
500 HP G.E. Induc. 1200 RPM
400 HP (2) G.E. Induc. 1200 RPM
450 HP G.E. syn. 80 RPM
150 HP G.E. Slip Ring, var. spd. 600 RPM

TRANSFORMERS

687 KVA (2) Maloney 13,800-460 V.
600 KVA (2) Pittsburgh 2300-550 V.
500 KVA (3) Al. Chal. 33,000-440 V.
500 KVA (2) G. E. 6600-2300 V.
500 KVA (2) G.E. 11950/6900-230/460 V.
333 KVA (3) G.E. 11000/22000/33000-115/230/460 V.
250 KVA (3) Packard 22,000-2300 V.
250 KVA (2) G.E. 6600-2300 V.
200 KVA (3) G.E. 2400/4160-600 V.
150 KVA (2) Maloney 2300-230/460 V.
100 KVA (3) Al. Chal. 22,000-440 V.
30 KVA (4) Packard 6600-110/220 V.

DIESEL ENGINE SETS

375 KVA Wghse. 3 ph., Busch-Sulzer
312 KVA Burke 3 ph.—Anderson
200 KVA G.E. 3 ph.—Busch-Sulzer
170 KVA F.M. 3 ph. style VA.
90 KVA F.M. 3 ph.—F.M. Style VA
40 KVA F.M. 3 ph.
50 HP F.M. "VA" belted

BOILERS

749 HP (2) Edgemoor 200 lb.
728 HP E.C. ver. 200 lbs.
600 HP Heine 200 lbs.
600 HP Connelly 200 lbs.
562 HP Edgemoor 200 lbs.
500 HP (4) Vogt 225 lbs.
471 HP E.C. ver. 160 lbs.
250 HP (2) E. C. 200 lbs.

AIR COMPRESSORS

2200 CFM Nordberg 100#—Motor & Steam driven
1080 CFM Nordberg 85#—165 HP. 230 V. DC Motor
250 CFM Chicago Pneu. 100#—75 HP AC Motor

PUMPS (motor driven)

3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
2200 GPM 400' head
1390 GPM 233' head
1000 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
650 GPM DeLaval 810' head
600 GPM Al. Chal. 450' head

BOILERS

1—813 HP **Edgemoor Boiler,** 200# pressure, Riley underfeed stoker.
1—335 HP **B & W Sectional Header Boilers,** 200# pressure with superheaters, hand fired grates.
2—516 HP **Sterling** 200# pressure boilers, ASME Code, with chain rate stokers.
1—400 HP **Wickes** 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. **Badenhausen Boiler,** 354# pressure.
1—357 HP **HEINE** with Riley Underfood **Stoker.**
2—600 HP **B & W** sectional header boilers, 200# pressure.
2—300 HP **Heine** 175# pressure.
2—492 HP **Sterling Boilers,** 160# pressure.
1—725 HP Sectional **Header Boiler** 225# pressure with underfeed stoker.
1—394 HP **Sterling Boiler** chain grate stoker, 160# pressure.
2—250 HP **Sterling Boilers,** 160# pressure equipped with gas burners and controls.
2—253 HP **Sterling Boilers,** 160# pressure with oil burners.
1—444 HP **Union Iron Works Boiler,** 225# pressure.
2—500 HP **Edge Moor Boilers** 200# pressure.
4—500 HP **Voigt Water Tube Boilers** 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP **B & W Sectional Header Boiler** 150# pressure, underfeed stoker.
1—522 HP **Sterling Boiler** 200# pressure with **Firite Stoker.**
2—404 HP **Springfield,** 200# pressure with chain grate stokers.
1—484 HP **Springfield Boiler,** 250# pressure oil burners.
2—350 HP **HEINE Boilers,** 150# pressure.
1—**Complete Power Plant** consisting of 2—309 HP **Heine Marine Boilers,** 223# pressure and 2 General Electric Turbines with all auxiliaries.
8—150 HP **HRT Boilers,** 150# pressure.
1—300 HP **Locomotive Boiler** 150# pressure with all trimmings.
3—250 HP **Erie City** vertical boilers with pulverizers.
1—400 HP **Connelly Boiler** 160# pressure with new tubes and auxiliaries.
2—84" x 20' **HRT Boilers,** 150# pressure all auxiliaries.
1—150 HP **HRT,** 125# pressure, rebuilt and guaranteed.
56—50 HP **Vertical Boilers** 150# pressure all auxiliaries.

TURBINES

1—5000 KW **Westinghouse** 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW **Allis-Chalmers** Condensing **Turbine** with auxiliaries.
1—2500 KW **General Electric Condensing Turbine** with auxiliaries.
1—2500 KW **General Electric Turbine** 400# pressure. Surface condenser.
1—1000 KW **Westinghouse non-condensing turbine** 350# pressure 16# back pres.
1—937 KVA **Allis-Chalmers Turbine.**
1—625 KVA **General Electric Turbine** with jet condenser.
1—2000 KW **Westinghouse Turbine** with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP **Kerr** Non-condensing 3600 RPM **Turbine.**
1—250 KVA **Waite Turbine** either condensing or non-condensing.
1—250 KVA **General Electric non-condensing Turbine.**
1—125 KW **General Electric non-condensing Turbine.**

ENGINE GENERATOR SETS

260 KVA **Skinner** uniflow engine.
1—750 KVA **Rice & Sargent** 3-60-600 volt engine generator.
1—480 KW **Rice & Sargent** 3-60-550 volt engine.
1—400 KVA **Murray-Corliss** engine.
1—375 KVA **Chuse vertical Uniflow engine.**
17 inch by 18 inch **Skinner** uniflow engine.
1—166 KVA **Ames Uniflow engine generator set.**
1—220 KVA **Chuse non-releasing Corliss engine generator.**
2—625 KVA **Bates-Corliss** engines.
1—48" x 150' **steel stack.**

DIESEL ENGINES

2—200 KVA **Fairbanks-Morse** Full Diesel **Engine Generator.**
4—312 KVA **MAN** full diesel engine generators, solid injection, 4 cycle.
1—**Busch Sulzer** Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
800 KVA **Nordberg,** full diesel engine generator.

ENGINE GENERATOR SETS

1—625 KVA **Nordberg** Uniflow engine.
1—1000 KVA **Skinner** Uniflow engine.
400 KW **Skinner** Uniflow **Engine Generator** set.

MISCELLANEOUS

54,000 pound **Cochrane** hot process lime and water softener.
2500 HP **Cochrane** Open Feed Water **Heater.**
1—10' x 15' **Illinois Forced Draft** Chain **Grate Stoker.**
1—#8 **Fuller Bonot Pulverizer.**
1—11 retort **Riley** underfeed stoker.
1—800 HP **Hoppes** open feedwater heater.

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building — LOUISVILLE, KY.

1—400 HP Westinghouse, type CW, 3 ph, 60 cy, 440V, 450 RPM slip ring motor

1—300 HP Westinghouse, 3 ph, 60cy, 440V CW slip ring motor 495 RPM

2—250 HP General Electric, 3 ph, 60 cy, 440V 1-17A 400 RPM

1—200 HP Allis Chalmers, 3-60-440V, 514 RPM

2—150 HP Allis-Chalmers, 3 ph, 60cy, 440V, 450 RPM slip ring

1—150 HP General Electric type KT, fr. 558 3-60-2200V 880 RPM

1—150 HP General Electric, type ATI, 3 ph., 60 cy, 440V 900 RPM, 0.8 PF syn. motor

1—150 HP Electric Mach. syn. motor 125 KVA, 3-60-220V, 1200 RPM

1—150 HP General Electric, 3-60-440V

1—17A 360 RPM slip ring

1—150 HP Westinghouse, 2 ph, 60cy, 440V frame 1000, CW, 390 RPM slip ring

1—150 HP G. E., 3 ph, 60 cy, 440V, 1170 RPM, type 1-6

2—125 HP Westinghouse CS774C 3-60-440V 860 RPM Ball Bearing

4—100 HP General Electric, 3-60-440V 495 RPM, MT 562 slip ring

1—100 HP General Electric type I, form K, 3-60-220V 575 RPM

Factory built, 3 bearing, Westinghouse motor-generator set, 16½ KW, 650 amp., 25 volt, 1750 RPM, SK93, generator direct connected to 26 HP, 230 V, DC, SK83 motor with complete panel.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring

1—100 HP, G. E., 3 ph, 60 cy, 440V, 580 RPM, type 1-15

2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring

1—75 HP Westinghouse, type CW, 3 ph, 60cy, 440V, 720 RPM slip ring, 3 or 2 bearings

1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring

1—75 HP General Electric, 3 ph, 60 cy, 440V, 500 RPM, MT558 slip ring

1—75 HP Western Elec. type I, 3-60-440V, 690 RPM

1—75 HP General Electric, 3-60-440V, type I, 575 RPM

1—75 HP, G. E., 3 ph, 60 cy, 220V, 1165 RPM, type KT-347

3—25/65 HP Westinghouse, frame 762C, 3-60-440V, 600/1200 RPM, 2 speed slip ring motor

1—60 HP General Electric type KT, frame 348, 3 ph, 60 cy, 440V, 870 RPM

1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage 900 RPM

1—60 HP, General Electric, 3-60-440V, 720 RPM, type I form K

1—60 HP General Electric 3-60-440V, 1750 RPM, type I slip ring

1—60 HP General Electric 3-60-440V, KT542, 870 RPM Sq. Cage

1—60 HP, Westinghouse, 3 ph, 60 cy, 220V, 1160 RPM, type CS-644C

1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM

1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, KT 346, 870 RPM, Sq. cage

1—50 HP General Electric 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP Howell 3-60-440V 870 RPM, type SCBB ball bearing Sq. Cage

1—50 HP General Electric 3-60-440V, 720 RPM, type I-K, Sq. Cage

2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring

1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring

1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring

3—50 HP General Electric 3-60-440V, 575 RPM, type I-K, fr. 13A, Sq. Cage

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers 3-60-440V, 490 RPM, Sq. Cage

1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring

1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D

1—50 HP, Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing

We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM

1—60 HP Westinghouse, type SK, frame 160, 230V, 680 RPM

1—60 HP Westinghouse type SK140L, 115V, 1150 RPM vertical

1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM

1—50 HP Westinghouse SK200, 245 RPM 230V

1—DC Generator 45KW Bullock 120V, 375A, 900 RPM

2—40 HP C & C 230V, 250/1000 (planer)

2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25cy-440V, 720 RPM, type MS, Sq. Cage

1—50 HP General Electric, 3-25cy-440V, 700 RPM, type I-M, slip ring

1—40 HP Westinghouse 3-25cy-440V, 730 RPM, type CI. frame 753A slip ring crane

1—35 HP Allis-Chalmers 3-25cy-440V, 720 RPM, slip ring

1—30 HP Westinghouse 3-25cy-440V, 720 RPM, CS, Sq. Cage

2—30 HP, Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 128 ball bearing

1—30 HP, Wagner, 3 ph, 60 cy, 440V, 900 RPM, type 19TCM, totally enclosed fan cooled, ball bearing

The Wente Electric Co.,

Hamilton, Ohio

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250 VOLT ROTARY CONVERTERS

1—1500 KW., Westinghouse compound interpole 250 v. D.C., 6 phase, 60 cycle AC Rotary converter, 600 RPM.

3 single phase, 2300 Volt transformers 1—DC and 1—AC panel for above.

2—1000 KW., Westinghouse compound interpole 250 volt DC, 6 phase, 60 cycle AC Rotary converter, 900 RPM.

2—Banks of 3 single phase, 2300 volt transformers for above and 2—DC and 2—AC panels.

The above in excellent condition.

1—3120-4030 KVA, 240-310 volts, 167 RPM, 6 phase, 25 cycle, General Electric Rotary, with transformers.

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500 KW G.E. 250 D.C. 2300/4000 A. C. 1200 RPM
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500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM

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360 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
300 KW WEST. SYN. 250V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300 A.C. 1200 RPM
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SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
900	2200	G.E.	900
500	2300	Whse	514
450	2300	G.E.	600
400 (2)	400	Whse.	514
400	2300	Whse.	1200
350	220–440	G.E.	1800
350	2200	G.E.	600
300	2300–4000	G.E.	1200
250	2300	G.E.	600
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–400	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	440	G.E.	1800
150	550–2200	G.E.	1800
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
75	220–440	G.E.	600

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

600	2200	Whse.	900
400	440–220	Whse.	276
350	440–220	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
110	440	Whse.	900

PUMP

1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

OUTDOOR OIL CIRCUIT BREAKER

1—New 400 Amp. Type FK, 136-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

TRANSFORMERS—60 CYCLE

3—667 kva., G.E., 2300/4000-460/480 Volts.
3—667 kva , Whse., 22000-2300.
3—500 kva., Whse., 22000-2300.
3—350 kva., G.E., type H-KD 13200-4600.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., Whse., 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
400	440	G.E.	KTP	1200
400	2200	Whse.	C.S.	1800
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
200	220/440	G.E.	IK	720
150	2200	Allis. Ch.	AN	450
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

MOTOR GENERATOR SETS

75 KW, 125 V, 1200 RPM Westinghouse Conn. to 112 H.P. 2300/440 V, 3 ph, 60 cy. Ind. motor.
1—75 KW 125 V, 1200 RPM, GE Conn to 100 HP 440 V. 3 ph. 60 cy. Ind. motor.
1—75 KW 250 V. 1800 RPM, Cr. Wh., Type CCD con. to 100 H.P., 2200 V., 3 ph., 60 cy. syn.
1—50 KW 250 V. 900 RPM, Whse. SK 407 to 78 HP 440/220 V. 3 ph. 60 cy. Ind.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2209 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—225 kva., 600 r.p.m., 2200-240 V., G.E.
1—187 kva., 900 r.p.m., 2200-550 V., Westghse.
1—110 kva., 900 r.p.m., 440 V. G.E.
1— 25 kva., 3600 r.p.m., 220 V. G.E.

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1-40 ton double Trolley Hand Crane

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1—5000 KW GE Cond. 2300 V.
1—4000 KW GE Cond. 2300 V.
1—3000 KW GE Cond. 600 V.
1—2000 KW GE Cond. 2300 V.
1— 750 KW West Cond. 6600 V.
1— 600 KW GE Cond. 600 V.
1— 500 KW GE Cond. 600 V.
1— 500 KW GE Cond. 125 V D.C.
1— 200 KW GE Cond. 2300 V.
1— 100 KW GE Cond. 600 V.
1— 75 KW GE N.C. 125 V. D.C.

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1—450 HP GE 175#
1—230 HP Terry 150#
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10000 CFM 33# Turbine Driven

Pumps

2—3000 GPM 65' Hd. Motor Driven
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Engine—Generators

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Belted Generators

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1—450 KW GE 360 RPM 600 V.
1—15 Ton Crane Hand Operated
1—150 HP Motor 720 RPM 2200 V.

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120 KW ENGINE GENERATORS SET

1—120 KW G.E. Co. Type TRE Generator, 3/60/2300 volts, direct connected to 125# Harrisburg Fleming Steam Engine.

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1—50 HP Lidgerwood Double Drum Hoist, 24 x 24" drums, side by side, with or without AC or DC motor.

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6—25 KVA 33000-2300
25—37½ KVA 2300-115/230
2—37½ KVA 2400/4800-120/240
2—37½ KVA 6600-220/440
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3—75 KVA 4000-115/230
2—75 KVA 11000-2300
3—75 KVA 13200-115/230
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3—150 KVA 6600-2300
2—150 KVA 13800/6900-115/230
3—150 KVA 13800-115/230
3—150 KVA 23000-115/230
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3—833 KVA 13200-240/480
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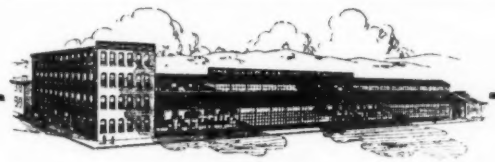

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4—48" Chapman Motor operated solid wedge gate valves non-rising stem.
1—20" Renssalaer #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod & Eyebolt, 100#
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1—DJXC Hercules, 6 cylinder, Diesel Engine, No L803473, bore 3¾", stroke 4½, 1800 RPM, direct conn. to 35 K.W. Star Gen. type GS-504, 3 ph. 60 cy. 220 v. 1800 RPM, p.f. 80%, unit heater, switchboard.

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G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3000	40′	Cameron	Centrif.
300	500′	Goulds	Triplex
240	460′	Worth.	Triplex
175	500′	Worth.	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
200	175′	Blackmer	Rotary
1500	460′	Platt	Steam
1000	460′	Knowles	Steam
500	460′	Knowles	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

STEAM ENGINE GENERATOR SETS D.C.

K.W.	Make	Volts	Type
50	G.E.	250	dir. dr. Eng.
35	Sturt.	250	belt dr.
25	Greenfield	115	belt dr.
25	G. E.	115	dir. dr.
2	Erie	115	dir. dr.
1	Moon	115	St. Turbine

MOTORS (D.C.)

100	Northwest.	220	1750
25	Imperial	220	450
25KW	Fair. Morse	110	1050

STORAGE TANKS

5 to 30000 Gal. Steel-welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

CONDENSATION RETURN UNITS

Nash-Jenn. Dup. Vac. Heat. 26000EDR
Nash-Jenn. Simp. Vac. Heat. 16000EDR
Skidmore Vac. Heat. 20000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
250	100	Ing. Rand	Horiz.
220	100	Gardner	Gas. Eng.

TURBO-CENTRIFUGAL

3000	16 lbs.	In. Rand	Motor dr.
2300	3 lbs.	Spencer	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
1500	16 oz.	Spencer	Motor dr.
1200	16 oz.	Spencer	Motor dr.
750	16 oz.	Spencer	Motor dr.
400	16 oz.	Spencer	Motor dr.

BLOWERS

C.F.M.	St. Press	Make	Type
100-60000	¼"-5"		Various
100-15000	¾"-16 oz.		Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press.	Make	Type
10000	2 lbs.	Roots	Belt dr.
6000	3 lbs.	Roots	Belt. dr.
3000	3 lbs.	Roots	Belt. dr.
2000	3 lbs.	Sturt.	Belt. dr.
1000	3 lbs.	Roots	Belt. dr.
200	5 lbs.	Baker	Dir. dr.
110	15 lbs.	Beach R.	Belt. dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt. dr.
350	27 in.	Worth.	Belt. dr.
300	27 in.	Nash	Belt. dr.
100	27 in.	Deane	Belt. dr.
200	29 in.	Devine	Belt. dr.

MOTORS (3 ph. 60 cy.)

H.P.	Make	Volts	Speed	Type
200	G.E.	230/4000	1800	Syn.
200	West.	440	690	HF
175	G.E.	440	1150	I
100	Lincoln	220	1750	
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.
30	Wagner	220	1150	

STEAM ENGINES

11"x12" G.E. Vertical
10"x10" Sturtevant Vertical
10"x10" Greenfield Vertical
3"x4" Erie Vertical
7"x7" Wickes Bros. Vertical
6"x6" Lawrence Vertical
1 to 25 H.P. Steam Turbines

SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES
HIGHEST PRICES PAID FOR YOUR SURPLUS EQUIPMENT

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140 Grand St., N. Y. C. Tel. CAnal 6-6983-4

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CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

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EBASCO SERVICES INCORPORATED
Two Rector St. New York, N. Y.

2—4000 KVA. 60 Cy. 3 Ph. TURBOS with Surface Condensers

1—3000 KW. TURBO 60 Cy. 3 Ph. 480 v.
HEAT EXCHANGER 606 tubes 1¼" x 9'6"
1500 CFM 2 STAGE AIR COMP. 275 Hp.
2200 v. 60 Cy. 3 Ph. Syn. Motor Dr.
24" Back Pressure Valve F&D
3—20" VALVES—F&D
200 KW. and 125 KW. ENGINE SETS (2303 V. 60 Cy. 3 Ph. with Auxls.)
453 NEW STIRLING BOILER TUBES 9 GA.

1—New FAN 66750 CFM
3—550 HP. STIRLING BOILERS
4—CENT. PUMPS 4166 GPM. 162′ Head with 440 v. 60 Cy. 3 Ph. AC. Motors
1—36000 GPM, 27′ head CENT. PUMPS
TRAVELING CRANE 75 ton Case, 64′ span, 3 motors. Also others.
750 KW. and 110 KW. AC HYDRO ELEC. PLANTS and others.
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350 HP, 200# working pressure B&W Stirling with stoker.
500 HP, 200# working pressure Edge Moor with Illinois Chain Grate Stoker."

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2—500 KVA 3 Phase, 60 cycle, 21000/11000 pri. to 600/480 V. sec. GE type HT form DD, outdoor type oil-cooled Transformers with 3-5% taps on primary
1—275 HP 600 RPM 440 V 3 Brg. GE type ATI Synchronous Motor with startg. eqt.
1—125 KW 440 V 3 Phase AC Gen. dir. con. to 10" x 10" Chuse horiz. 1 cyl. vert. steam eng. and sw. brd.

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156 Montgomery Street
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Sutter 3943-4

FOR SALE

2—868 Cu. Ft. Sullivan Angle Compound Electric Driven Compressors—150 H.P., A.C. motor Texrope drive.
1—445 Cu. Ft. Worthington two stage direct coupled Electric Compressors, 75 H.P., A.C. motor.
1—10x6x12 Worthington Simplex outside packed Steam Pump.
1—16x9x12 Fairbanks Morse Underwriters Duplex Steam Pump.

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Reconditioned Motors, Generators, Control Equipment, etc.
Send for 32 page stock list.
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Specialists on Rebuilding Motors. Generators and Controls.
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1—0-5000# Pressure Recorder Model LR Esterline Angus, motor driven, factory rebuilt.
1—0-125# Pressure and Vacuum Recorder, Bristol, spring driven.
1—50-250 Deg. F Temperature Recorder, Foxboro, spring driven.
1—0-3000 Deg. F Temperature Recorder, Brown Instrument Co., 17 station, electric driven.
1—0-1000 Deg. F Temperature Recorder, Bristol, Model 367, electric driven.
1—0-600 KW Westinghouse Recording KW Meter, electric driven.
John D. Crawbuck Co., Pittsburgh 22, Pa.

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

POWER EQUIPMENT FOR PROMPT SHIPMENT

SQUIRREL CAGE MOTORS (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
400	West.	2200	500	CS
125/40	CR. Wh.	2200	700	125AQ
125	Burke	220/440	1200	
125	Cr. Wh.	2200	700	125AQ
80	G.E.	220/440	720	I-K

DC SERIES & CPD. MOTORS

HP	Make	Type	Speed
2	R & M	122	1000
5	R & M	125	1000
15	West.		650
20	G.E.	DLC	780
25	Shaw		600
25	G.E.	CO 2002	600
35	G.E.	DLC	460
50	Shaw		600
50	G.E.	RCP	1750
60	Al. Ch.		700
60	G.E.	DLC	575
80	G.E.	MD 108	480
100	G.E.	CO 1812	550
150	G.E.	MDS 1901/4	475

SLIP RING MOTORS, (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
200	G.E.	2200	240	MT 412
150	Al. Ch.	2200	685	
150	G.E.	220	575	I-M
125	Al. Ch.	2200	435	
100	Al. Ch.	220/440	575	
100	G.E.-25 cy.	220/440	500	MI-108
75	G.E.	2200	695	I-M
50	G.E.	2200	900	I-M
50/12½	G.E.	2200	900-450	I-M
12½	G.E.	2200	450	I-M

"Wound Rotor Motors" (3 ph. 60 cy.)

HP	Make	Volts	Speed	Type
200	G.E.	2200	600	I-L
150	G.E.	2200	600	I-L

TRANSFORMERS

Qu.	KVA	Make	Voltage
2	25	G.E.	2200/244/488
3	37	West.	4400/185
3	37½	West.	2200/440/220
1	37½	Pgh.	2200/110/220
3	50	G.E.	22000/2200
3	75	G.E.	2300/110/220

OIL ENGINE DRIVE AIR COMPRESSORS

Chicago Pneumatic simplate valve type, NS03 straight line 16½ & 11 x 18" capacity 492 cu. ft. displacemest, 100# pressure, with air receiver and starting air compressor.
2—14x10" Sullivan 505 cu. ft. compressors.
1—10x12 Ch. Pneu. 164 cu. ft. steam compressor.

M-G SETS 3 ph. 60 cy. (Syn.)

150 KW Ridgway 250 v. DC 2200 v. AC 900 RPM

ELECTRIC LOCOMOTIVES

4—6 Ton G.E. Storage Battery Loco. 44" Ga. with Batteries (Can change to 36" Ga.)
2—5 Ton West. 250 v. 36" Ga. with Gathering reels.

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2—4' x 5' Tyler Hummer Screens with Vibrator.

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POWER PLANT, with 2, 300 H.P. Boilers complete with 2,500 KW 3/60/2300 Turbines
2—300 H.P. Water Tube Boilers
1—453 H.P. 160# Stirling W. T. Boiler

COMPRESSORS

248 CFM Chi Pneu with 50 H.P. A.C. Motor
300 CFM Chi Pneu Type GSB with 75 H.P. 3/60/440 v. motor and auto. starting compensator
526 CFM Ingersoll-Rand, belt drive
780 CFM Chi-Pneu with 125 H.P. A.C. Motor

MOTORS

3 H.P. to 75 H.P.—A.C. & D.C. Units
(Write for our complete electrical list)

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60 H.P. Type U Buckeye Diesel Generator 42½ KVA, 3/60/440
300 H.P. Buckeye Diesel Eng. & Gen. 3/60/240
100 KW Allis Chalmers 3/60/2300 Generator, Skinner tandem compound steam engine
500 KW G.E. Skinner Uniflow Steam Eng. Gen. 250 D.C.
5000 KW Turbo Generator, 3/60/2300-3600 RPM
POWER PLANT—Complete with 2, 625 KW Turbo Gen.

1000 KW Frequency CHANGER SET 25 to 60 Cycles

60 cycle unit 4150 V. 25 cycle unit 9000 V. Complete with starting equipment.

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Superior Iron Works, sgl. drum, 36" dia. with 80 H.P. G.E. Type MTC motor.

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"Anything containing IRON or STEEL"

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STEAM — ELECTRIC — HYDRO — DIESEL

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BOILERS: 2500 HP, 1460, 1000, 800, 750, 680, 620, 565, 500, 400, 250, 200 HP:—Makes—B&W, Heine, Edge Moor & Others

TURBO-GENERATORS:—7500 KW, 5000, 4000, 3200, 2500, 2000, 1500, 1250, 1000, 750, 500, 300 & 200 KW

Non-Condensing: 1500 KW, 1200, 1000, 600 300, 200 KW, All Makes

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Phone—Worth 2-0455

IN STOCK FOR IMMEDIATE DELIVERY

D.C. ADJUSTABLE SPEED MOTORS, 230 VOLTS

Qu.	HP	Make	Type	Speed
1	35	Westinghouse	SK	300/1200
1	30	Roth		400/1200
6	30	Westinghouse	SK-130	600/1200
1	30	Westinghouse	SK-130	600/1800
1	25	Electric Dynamic		750/1225
1	30	General Electric	RLC	500/1500
1	15	Westinghouse	SK-105	500/1500
1	15	Westinghouse	SK-163	187/300
1	15	Sprague	LC	500/1100
1	10	Westinghouse	SK-90	400/1600
1	10	General Electric	RF-10	400/1600
3	10	Reliance	78T	500/1500
2	10	Electric Dynamic	5S	600/1200
1	10	Westinghouse	SK	500/1500
1	11½	Westinghouse	SK	600/1200
3	10	General Electric	RLC-115	400/1200
1	7½	Electric Dynamic		450/1350
1	7½	Electric Dynamic	S7½	300/1200
5	5	Westinghouse	SK-60L	500/1500
3	5	Reliance		600/1800
6	3½	Westinghouse	SK-40	450/1800
6	3	Westinghouse	SK-43	500/2000

KULLER & CHISWICK 245 CENTRE STREET, NEW YORK CITY (13) N. Y.

CANAL 6-6033

TURBO UNITS—60 CYCLE

1—5000 KW G.E. condensing.
1—3200 KW Allis-Chalmers condensing.
1—2500 KW G.E. condensing.
1— 500 KW West. condensing.
1— 300 KW G.E. non-condensing.

TRANSFORMERS

Single Phase, 60 Cycle.

3—150 KVA Pittsburgh, 6600/220-440 V.
3—100 KVA G.E. 13,200-6600/2200 V.
2— 75 KVA West. 6600/230-460 V.
3— 30 KVA West. 2200/220/110 V.

ELECTRIC MOTORS

3 Phase, 60 Cycle.

1—165 HP G.E. Syn. 2200 volt, 900 RPM.
1—125 HP West. Syn. 2200 volt, 1200 RPM.
1—100 HP Crocker-Wheeler Syn. 220/440 volt, 1200 RPM.
1—100 HP West. Type CW Slip Ring, 2200 volt, 700 RPM.

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CONDENSERS

1—Worthington 12,000 sq. ft. surface type

1—Alberger 15,000 sq. ft. surface type

25 cycle Motor Generator Set

G.E. generator, 300 KW, Type MP.

G.E. Motor, 450 H.P., 2300 V., 3 Phase

This equipment is used.

Condition is excellent.

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DEEP WELL PUMPS

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DEAN-HILL, Centrifugal
22½" casing
40-85 ft. lift. 290 ft. head.
150 HP Slip Ring Motors
3 ph. 60 cyc. 440 V.
Auto Control Panels.

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1—Curtis Steam Turbine, G. E. Co. #27774, Form A, 30 KW, 1200 RPM, Type D.5I, 1-stage. 125# steam pressure, non-condensing.
1—8"Crane #25-384 Vertical Back Pressure Valve, iron body
1—8" Crane #150 Gate Valve, iron body
1—8" Swartwout Cast Iron Exhaust Head
1—8" Badger Multi-Corrugated Type Expansion Joint
1—3" Crane #250 Valve, iron body, brass trimmed
6—8" Cast Iron Elbows
1—Generator, G. E. Co., 1200 RPM, 3-phase, 90 amp., 240 volt, 30 DW, 60 cycle, 10 amp. exciter, 125 volt, 1.25 KW, direct connected.
1—Switch panel with main line circuit breaker and field switch
1—Amp. Meter, 1-volt
2—Rheostats
2—Auto Transformers
2—8-KVA, 220 and 110 volts

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MOTORS

3 phase 208 volts

4 speed Westinghouse CS. with Magnetic Brake 7.5 H.P. 1750/1140/875/565 R.P.M.
2 speed Lincoln 14.8 H.P. 600/1200 R.P.M.
2 speed Westinghouse CS. 15 H.P. 325/1000 R.P.M.

2 phase 220 volts

2 speed A.B. See 27.5 H.P. 600/1200 R.P.M.

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34 JUMEL PLACE NEW YORK CITY

DIESEL ENGINE FOR SALE

2—210 H.P. Cooper-Bessemer Full Diesel Engines. Solid Injection, 6 Cylinder, 4 Cycle, 325 RPM.

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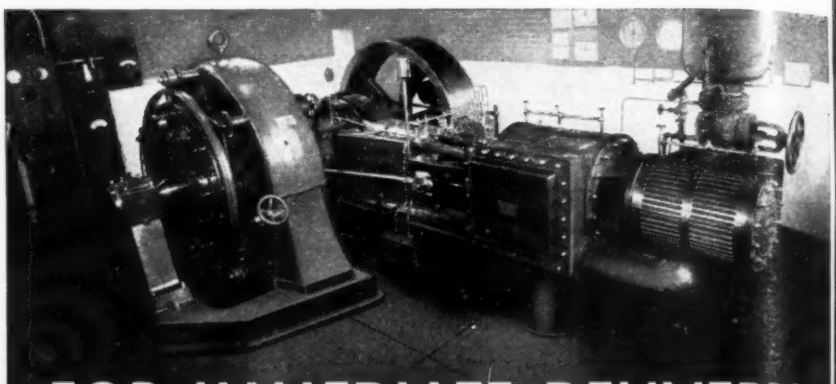
Main 4-3804-5



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This Complete DC Engine-Generator Unit AT THE PLANT OF HAYS MANUFACTURING COMPANY, ERIE, PA., U. S. A.

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1. Skinner Engine 16½" x 26" x 20" Horizontal Tandem Compound High Speed Automatic with Balanced Slide Valves: 125#, 150#, 175# Steam Pressure; direct connected to one Allis-Chalmers 225 K. W. Bullock Type Generator, specification 8 poles Compound wound 200 R. P. M. 230/240 Volts, 938 Amps. The engine completely rebuilt in May, 1937, and is in excellent condition.

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Reconditioned Diesel—Steam—Natural Gas Engines, Boilers, any type and h.p. Reconditioned Pipe, Valves and Fittings. High Tensile Steel Rods. Contact us before you buy.

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Good condition. With Stoker, Fan and Superheater. 207 lb. Pressure. Priced right.

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Do you need competent men for your staff? Men experienced in power operations? Men to fill executive, sales or technical positions?

Or are you one of the readers of POWER seeking employment in any of these capacities?

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Or are you seeking buyers for surplus used equipment from your plant—or to buy such equipment from other plants?

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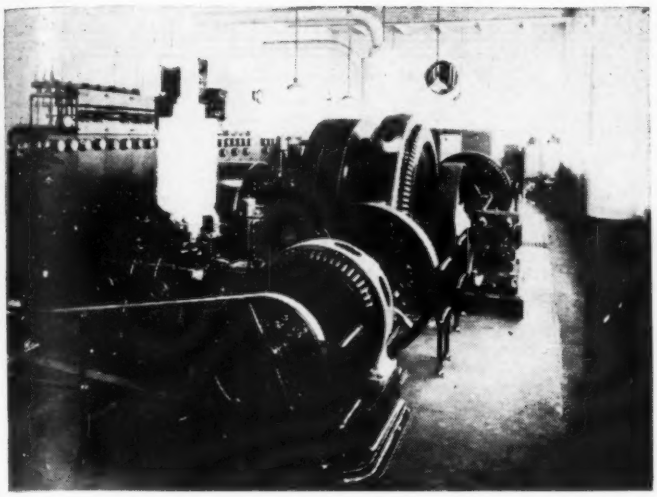

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2 Skinner Uniflow Engines with Westinghouse Generators and Exciters rated 1000 and 62½ KVA both 440 V-60 C- 3 Ph.

Sell as unit or separately. Plant open for inspection. Can operate for interested parties.

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WATER GENERATORS **STEAM ENGINES**

1—300 KVA Electric Mach. Co. 2300 V. 3 ph. 60 cy. 514 RPM.
2—300 KVA Electric Mach. Co. 2300 V. 3 ph. 60 cy. 300 RPM. (Necessary exciters, water wheels, etc. for above.)
1—650 HP Skinner Engine. It has one flywheel driving 200 KW generator, another driving paper mill.
3—B&W Ohio Standard Stirling Boilers, 133 HP each.
60—Westinghouse type "S" Disconnect Switches, various sizes.
100—Watt hour meters, G. E. type 1-14, single phase.
100—Westinghouse watt hour meters, type O-B, single phase.

HETZ CONSTRUCTION COMPANY
WARREN OHIO

SLIP RING MOTORS
40 HP. 600 RPM. 3/60/440 V. General Elec.
75 HP. 1800 RPM. 3/60/220 V. Wagner

SYNCHRONOUS MOTORS
55 HP. 1200 RPM. 3/60/440 V. Gen. Elec. ATI
150 HP. 720 RPM. 3/60/220 V. Gen. Elec. ATB

AC GENERATORS
150 KW. 225 RPM. 3/60/2300 V. Ft. Wayne TRC
150 KW. 600 RPM. 3/60/220 V. Gen. Elec. ATB
200 KW. 720 RPM. 3/60/240 V. Gen. Elec. ATB

FREQUENCY CHANGERS
2—40 KW. 60/80 cycle 3/60/220 V. Gen. Elec. ITT

ENGINE—GENERATORS
42 KVA. 3/60/240 V. Gen. Elec. TRE dir. con. to 60 HP. Brownell steam engine—complete.
75 KVA. 3/60/240 V. Crocker-Wheeler gen. dir. con. Russell steam engine—complete.
75 KVA. 3/60/2400 V. Westinghouse gen. dir. con. Ideal steam engine—complete.

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721 South Wyman St. Rockford, Illinois

AVAILABLE AT ONCE
Turbo units from 500 KW to 15000 KW.
Boilers from 125 HP to 1500 HP.
Diesel units from 10 KW to 1200 KW.

Stephen A. Douglass Co.
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FOR SALE

LOCOMOTIVES

3—75 ton 0-6-0 switchers, tractive effort 35,300#, 44" centers, coal burners.
2—65 ton 0-6-0 switchers, 44" centers, oil burners, two years leeway on flues and lagging. Ready for service.
1—120 ton 0-8-0 switcher, built 1923, tractive power 49500#, 50" centers. Rigid wheel base 16'0".

We can fill your requirements for locomotives—cars—rails.

WRITE—WIRE—'PHONE

Locomotive Export Division
EXPORTING & IMPORTING CO.
P. O. Box 2576 Dallas, Texas

IMMEDIATE DELIVERY

150 HP Stanwood horizontal fire box boiler, self-contained, ASME, 125#, with fittings.

1250 KW Westinghouse turbine generator set, on original foundation, with fittings and attachments.

THE ACME EQUIPMENT COMPANY
14057 Schaefer Highway
Detroit 27, Michigan

250 KW 125 V. 320 RPM with 4 cyl. 11 x 12 vertical uniflow steam engine, equal to new unit.
NEW 400 H.P. 4 cyl. 11 x 10 Vertical Uniflow steam engine bare unit. Supply any generator.
50 KW GE 125/250 V. Marine Set.
200 K. W. 125 V. or 250 V. Skinner Uniflow engine.
750 K.W. 250 V. 720 R.P.M. Interpole generator.
740 KW 250 V. Induction bleeder turbo set, geared.
Boilers of all sizes, stokers, oil burners.
Turbine Sets, A.C. and D.C. to 1000 K.W.
Diesels of all sizes, large and small.

Send your lists of equipment

JAMES K. HOOPER
50 CHURCH ST. NEW YORK

Almost New Stokers

4—Type A. Hoffman Firite in sets of 2 each with fronts, 56 sq. ft. grates and #45 Clarage A.C. electric driven fans for each set.

C. E. HOOTMAN
705 Olive Street St. Louis, Missouri

FOR SALE

One 100 K. W. 250 volt D. C. **Turbo Generator Turbine-Curtis** Form C, 2 stage 3600 R.P.M. 150# S.W.P.
Generator—100 K. W. **General Electric** Type MFC, Class 4-100-3600 Form T, 400 Amps 250 volts D. C.

PILOT MARINE CORP.
25 Beaver Street New York, New York

FOR SALE

1—50,000 & 70,000 Gallon Tanks & Towers
600—BRAND NEW Industrial Exhaust Fans
2—1452 HP. 350# P. Water Tube Boilers
2—200 HP ASME Code H.R.T. Boilers
2— 65 HP ASME Code Loco. Type Boilers
1— 75 Ton, 65' Span, O.E.T. Crane
1—168 KW AC Gen. D/C Skinner Unaflow Eng.

H. & P. MACHINERY CO.
6719 Etzel Ave. St. Louis 14, Mo.

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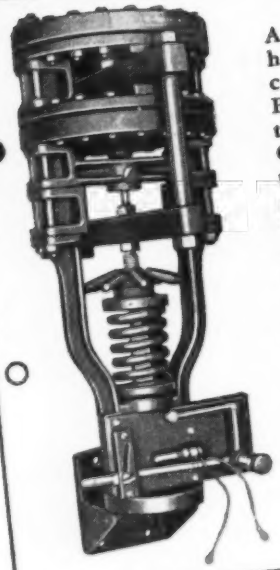
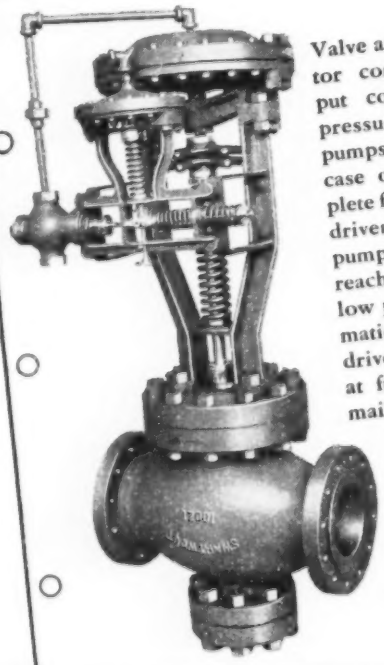
Engineered to meet your needs — Swartwout *Special* Controls

These quick "case studies" give you an idea of the many unusual jobs that are "licked" by adaptations of Swartwout Equipment.

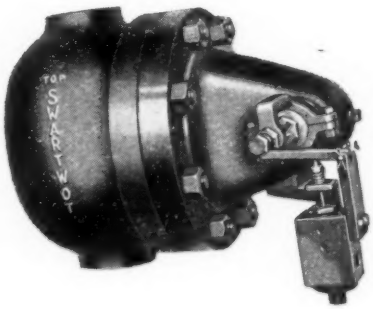


A Master Regulator which has wide application in control of Power Plant Equipment where differential pressure is involved. One of the common applications is "cutting in" of high pressure motor driven boiler feed pumps in case differential between steam pressure and feed water pressure reaches a predetermined low point. Also used to cut in auxiliary pumps to high pressure feed water heaters when regular water supply completely or partially fails. Sensitivity is adjustable between a few inches of water up to a normal variation of 42".

This particular valve is a single seated unit for dead-end service. It is installed in the steam line to a high pressure boiler feed pump. The operating piston on the valve is connected to the boiler feed water system. Normally the boiler feed is supplied through motor-driven units, this control valve cuts in the turbine-driven unit and maintains boiler feed supply automatically.



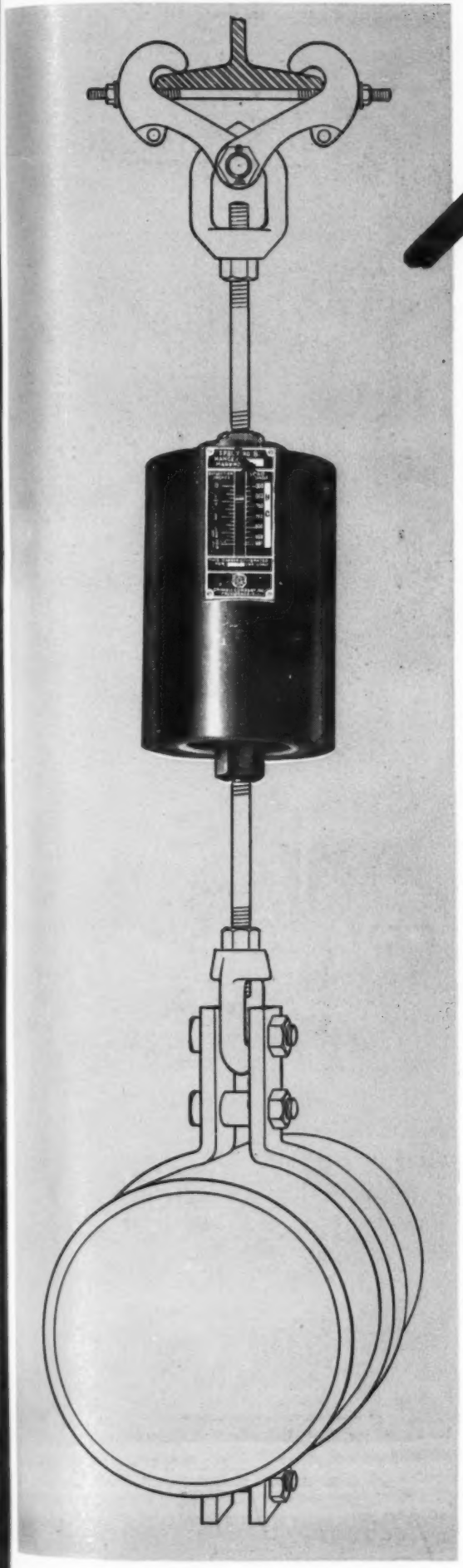
Valve and master regulator combined, used to put constant discharge pressure turbine-driven pumps into operation in case of partial or complete failure of the motor-driven units. When the pump discharge pressure reaches a predetermined low point, this unit automatically puts a turbine-driven pump on the line at full speed and it remains on the line, without throttling, until manually reset. A full automatic control can also be provided in addition to the quick opening feature illustrated.



This control unit is particularly adapted to "on and off service." When installed on a high pressure heater, it is used to operate two or more valves in the boiler feed system, so that in case of tube rupture, the heater is bypassed and feed water is supplied to the boiler without interruptions in a matter of 10 seconds or less. Likewise on high pressure installations it is used in connection with overflow valves.

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio



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